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TRAINING SPEECH SOUND DISCRIMINATION IN CHILDREN WHO MISARTICULATE--A DEMONSTRATION OF THE USE OF TEACHING MACHINE TECHNIQUES IN SPEECH CORRECTION. FINAL REPORT.

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THIS REPORT DISCUSSES THE RESULTS OF A TWO-YEAR DEMONSTRATION PROJECT IN WHICH SCHOOL AGE CHILDREN WITH FUNCTIONAL ARTICULATION DISORDERS ROUTINELY RECEIVED AUDITORY DISCRIMINATION TRAINING BY PROGRAMED INSTRUCTION IN AN ACTUAL CLINICAL SETTING. AUDITORY DISCRIMINATION PROGRAMS FOR THE TEN MOST FREQUENTLY MISARTICULATED ENGLISH CONSONANTS WERE WRITTEN, EVALUATED AND USED WITH THE APPROPRIATE PORTION OF THE CLINIC POPULATION. PRE- AND POST-PROGRAM TEST SCORES ON MEASURES OF ARTICULATION, GENERAL AUDITORY DISCRIMINATION, AND DISCRIMINATION OF THE SOUNDS RELATED TO PROGRAM CONTENT WERE GATHERED. THIS REPORT DESCRIBES THE PROGRAMS, THE INSTRUMENTATION DEVELOPED FOR ENTIRELY AUTOMATED PROGRAM PRESENTATION, AND CHANGES IN POST-PROGRAM TEST SCORES. THE EFFECTS OF ROUTINE USE OF PROGRAMED INSTRUCTION WITHIN A MORE CONVENTIONAL CLINICAL SETTING IS ALSO CONSIDERED. (AUTHOR)

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Audrey L. Holland

March 1967

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I. INTRODUCTION

The application of behavioral technology to the teaching of subject matters and basic skills is currently the subject of much experimentation. The use of the teaching machine, programmed textbooks and automated instruction methods in general is becoming an accepted and respected educational reality. There is, moreover a body of research suggesting that applications of these techniques extend beyond teaching of subject matters, and have relevance to a number of more specialized educational problems as well. (5, 8, 11, 19, 20) One of the most pertinent of these is the extension of the concepts of programmed instruction into the practice of speech pathology. (2, 3, 4, 6, 7, 15, 16) The advantages of programmed instruction and teaching machine techniques for the speech clinician are the same advantages which pertain to automated teaching in general; that is, the effectiveness and efficiency of the educational process is increased. Not only can training be accelerated but the speech clinician in the process is freed from some of the more routine aspects of correcting devient speech, and can devote the time saved to the more exacting and individualized aspects of speech problems. This advantage is particularly pertinent for the public school speech correctionist, whose large case loads often allow for only the most cursory therapy. There is also another advantage to programming and programmed techniques, however. Development of a program in a clinical area requires that the programmer systematically explore the behavior to be trained; the process of writing an adequate program often generates clearer and more explicit information as to the nature of the training process per se.

Programmed instruction techniques seem to have particularly great potential to the clinical management of problems of articulation. In part, this is because of the preponderance of disorders of functional articulation in the case loads of public school speech correctionists. Thus, techniques which can increase the efficiency of the training procedure are most needed there. The major reason, however, is because one of the major avenues of remediation, that of speech-sound discrimination training, appears to be uniquely "programmable." Auditory discrimination training is a conventional phase in clinical work with persons who misarticulate the sounds of a language. Such training is based on the rationale that while no generalized deficit in auditory discrimination seems to exist for these persons, specific discrimination difficulties related to the misarticulated sound are likely to be present. (23) Further, sound production learning seems to be effectively facilitated by sound discrimination training. (6) Traditional techniques for teaching discrimination for deficient speech sounds involve games and exercises devised to expose the child to progressively more and more subtle speech sound discriminations. The child's behavior consists of listening carefully to the discrimination items, and making judgments about what he hears. Such judgments are amenable to instrumentation that requires a response to each item before moving on and can provide reinforcement for correct responses. The listening task itself can be developed into a series of items that fulfill the behavioral requirements of good teaching machine programs; they can be designed to incorporate gradual progression and fading, and include a wide range of speech-sound examples. Indeed, Powers has outlined a method for training speech-sound discrimination, which uses the basic principles of good programming in its insistance upon moving from gross to finer and finer discriminations, suggesting tasks which require the student to respond, and giving the child feedback as to the appropriateness of his response. (13)

The project described here grew out of the investigator's doctoral dissertation. An automated teaching technique was developed for teaching discrimination of the /s/ phoneme to children who misarticulated that sound. This technique was modeled upon Powers' format. The experimental evaluation of the technique, and subsequent follow-up procedures (1), indicated that the technique was feasible, that it was effective in handling this phase of articulation correction, and generally was more efficient than traditional methods. The dissertation, however, was more concerned with evaluating general applicability of programmed instruction to the problem of training speech-sound discrimination than with exploring its practical usefulness to speech correctionists. For example, a program was developed for use with only one defective phoneme, rather than a battery of programs for use with a number of defective phonemes. Further, the program presentation was only partially automated. And finally, children currently enrolled in speech clinics were excluded from the study rather than integrated into it from actual clinical case loads.

It was the aim of the project described here to explore the practical feasibility of teaching auditory discrimination skill to children who misarticulate using programmed techniques based on the research described above. Specifically, the objectives of the project were to:

1. Develop a series of automated instructional programs, each designed for use with a different phoneme.

2. Develop fully automated equipment for administering these programs.

3. Set up a laboratory-clinic room with two teaching machine units with which to use these programs.

4. Use the automated instructional setting routinely in an active speech clinic situation in order to evaluate the practical aspects of such automation.

5. Gather data regarding the role of programmed auditory discrimination training in correcting misarticulation.

The subsequent sections of this report will describe the steps taken to fulfill these objectives.

II. METHODS

The methods which were employed varied as a function of the objective they were intended to realize. The methods by which each were studied will, therefore, be discussed separately.

A. Development of the Programs

Teaching machine programs were developed for the consonant sounds /s/, /z/, /r/, /l/, /ʃ/, /k/, /g/, /f/, /θ/, and /ð/. These consonants were chosen because, according to most surveys, they encompass the most frequently misarticulated sounds of English. The model upon which these programs are based was the prototypical /s/ program mentioned above. This program followed Powers' outline for improving discrimination skills. The prototypical program required the child to learn a series of finer and finer auditory discriminations; first, discriminating the sound free from phonetic contexts from other isolated speech sounds; second, discriminating the presence of the sound in one of a pair of words; third, discriminating where a sound occurs in a simple word; and fourth, discriminating correct from incorrect sound production.

The specific tasks encompassed are summarized below:

A. Discrimination in isolation
B. Discrimination between two words
    1. Which word begins with the sound?
    2. Which word ends with the sound?
    3. Which word has the sound in the middle?
C. Discrimination within a single word
    1. How many instances of a given sound occur in a particular word?
    2. Where in a word does the sound occur?
D. Discrimination of correct from incorrect sound production
    1. One word articulated twice (once correctly and once incorrectly) which was correct?

All ten programs were recorded on a Tandberg tape recorder which had response compatibility with the tape recorders used in the teaching machine. Each was recorded in a soundproof room, and both male and female speakers were used. Each program has approximately 600 items. The appropriate directions for each program were recorded on the program tape. A male speaker recorded these directions.

The first step in the writing of the speech-sound discrimination program involved determination of which consonants should be compared with the training sound and in what order the chosen phonemes are to be paired with the training sound. This determination was made objectively by referral to Halle and Jakobson's work on distinctive features of phonemes. (10) Consonant sounds which shared no features were discarded; total number of distinctive features within this constraint determined the similarity of a given sound to the programmed sound, with highest number of shared features being its closest match. In general, this constituted our guideline for the selection and order of the "wrong" sounds to be incorporated within each program. In some instances, however, practical problems over-rode such neatness in the order of "wrong" sound items. For example, the closest sound to most sounds programmed here was its voiced and voiceless correlative. The criterion items for, say the /s/ program's discriminations in the initial position thus should be /z/. However, items involving initial /z-s/ discriminations are extremely limited, and in most instances, the concept of minimal word pairs cannot be used. Further, a typical /s/ error involves a /θ/ approximation. Thus, criterion items in this case involved /s-θ/ discriminations.

The determination of words to use was made by referral to the Thorndike-Lorge lists. (23) Words which did not appear in the first 3,000 were eliminated unless it was clear that children would be familiar with them (such as "television") or unless the unfamiliar word was mandatory for teaching a particular discrimination because no more familiar word possessed similar properties. (In effect, these unfamiliar words can be viewed as the "nonsense words" of the programs. Practice with such words is not antithetical to good discrimination training.)

Another general consideration regarding construction of the programs involved presentation format. For example, it is feasible to design a task for training discrimination of initial consonants in which the subject has merely to judge if a given word began with, say, /l/; he could have been instructed to push one button if the word did so, and another if it did not, and items could have been efficiently programmed. However, wherever it was possible, pairs of words were used instead. This decision ensured that every item (after the initial isolated phase) had at least one presentation of the well-articulated phoneme. Part of the practical function of discrimination training is that it alerts the child to the wide range of phonetic contexts in which his error sound occurs. Using pairs of words is an efficient way to increase the child's opportunities for hearing a large variety of words containing his sounds. It further ensures that within every item, he will hear at least one well-articulated example of his sound.

In order to clarify the programs' construction, a description is included for each program. All programs were essentially similar in both format and inclusion of programming principles. The variations among them are primarily a function of the use of a given phoneme in English. Therefore, following the first program description, all other programs will be described in terms of the constraints that English imposes upon the format.

1. The /s/ Program

Although the prototypical program involved /s/ discrimination, the evaluation and error analysis suggested some rather basic item revisions, shortening of some sections and lengthening of others, etc. Thus, rewriting of the /s/ program was undertaken.

a. Phase 1. Discrimination of /s/ in isolation from other isolated speech sounds. Recognizing a sound and differentiating it from other sounds when all are free of phonetic context requires only gross discrimination skill. To ensure that this discrimination was made immediately, the early presentations of /s/ were longer and louder than non-/s/ sounds. This was gradually faded until all sounds were of roughly equal loudness and length. The earliest discriminations involved /s/ and other speech sounds moderately dissimilar to /s/. As the program progressed, sounds which required finer discriminations were incorporated. Final items dealt with distortions of /s/.

For the items in this phase, the child pressed a blue button when he heard /s/. When he heard any other sound, he pushed a red button.[1] Sounds were recorded so that there was a period of eight seconds between the presentation of one sound and the sound which followed it. Roughly half of the sounds were /s/ sounds; the other half were non-/s/ sounds. Whether a given item was to be an /s/ or a non-/s/ sound was determined by referral to a table of random numbers.

b. Phase 2. Discrimination between two words: Which word in a given pair begins with /s/, has /s/ at the end, has /s/ in the middle? Discrimination of sounds at the beginning of words is easier than discrimination of final sounds; discrimination of final sounds is easier than discrimination of sounds occurring medially in words. This rule determined the order of discrimination tasks posed in this phase of the program. A series of items requiring discrimination of /s/ at the beginning of words preceded a series of items requiring discrimination of /s/ in the final position. A series of items requiring discrimination of /s/ when it occurred medially in words constituted the terminal section of this phase. The child's task was to determine which of a pair of words began with (ended with, or had in the middle) the /s/ sound. He was instructed to push button number one if word number one began (etc.) with /s/, and button number two if word number two began (etc.) with /s/.

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[1] A complete discription of the control apparatus and the response panel will be given in the second major portion of the methods section. However, it should be pointed out here that the subject faced a response panel on which were three large plastic discs, or buttons. The buttons were colored blue, red and yellow respectively, had large white numerals (1, 2 and 3) -- painted beneath them and were placed in a row on the response panel. Each of these features (position, color, and numeral) -- was used in controlling responses at some point in the program.

For early items involving initial discriminations, the /s/ word was stressed. Such emphasis was gradually faded as the program progressed. This part of the program began with items in which the whole phonetic structure of the non-/s/ words was much different from the /s/ words, gradually progressed through items in which the non-/s/ words rhymed with the /s/ words but began with sounds very different from /s/, went on through items where the initial sound of the non-/s/ words was similar to /s/ but which differed in the remaining phonetic context, and finally included items where the non-/s/ words rhymed with the /s/ words and in addition had initial consonants which were very similar to /s/.

For the items involving final discriminations, a progression similar to the above was used, differing only in that final, rather than initial sounds were under consideration. Late in this part of the task, incorrect words which had /s/ in other positions were used. This was to insure discrimination of final /s/, rather than just discrimination of /s/ somewhere in a word. For the items involving medial discriminations, the same general principles of emphasis and fading out were followed, and again, the incorrect word in each item gradually progressed toward greater and greater phonetic similarity to the paired /s/ word.

The time allowed for each item (from the beginning of one item to the beginning of the next) was eight seconds. This interval was constant for the remainder of the program, and was chosen because it allowed ample time for most children in the prototypical study.

c. Phase 3. Discrimination within one word. Two types of discrimination tasks are subsumed under this phase. The first of these, involving listening to a word and determining how many /s/ sounds there are in it, is viewed as a transitional task. The child had, for some time now, been attending to either initial, final or medial word-segments. The series requiring him to listen to and count the number of /s/ sounds within a word was included to insure that he would begin to listen to whole words. These items, then were designed to bridge the child's discrimination of parts of words and to prepare him for the second type of task in this phase -- that of listening to a series of single words, all of which contained an /s/ sound, and determining whether the /s/ occurred initially, medially or finally.

For the transitional task, the child was instructed that he would hear some words presented one at a time. Some of these words contained one /s/ sound; some had two. He was to decide how many, and push the appropriate button. Gradual progression was again most important. Early items had one or two quite obvious /s/ sounds. Close to the end, the items required that the child discriminate between sounds that are similar to /s/ in order to count the correct number of /s/ sounds.

For the second task in this phase, the child was asked to determine the position of /s/ within a word. The items in this task forced the child to listen carefully enough to respond to the position of the /s/ sound in each word. He had, by now, been trained in discriminating the /s/ sound in every position in words; but now he had to respond differentially to the position taken by /s/ in a given word. He pressed the first button for an initial /s/, the middle button for a medial /s/, and the end button for a final /s/. The earliest items had exaggerated /s/ sounds, were easily recognizable as to /s/ position, and furnished systematic practice for all three positions before the words were randomized as to position. Gradually the changing of /s/ position in a similar word was presented; and lastly, final discriminations involved words which have within them, in addition to /s/ sounds, sounds similar to that phoneme.

d. Phase 4. Discrimination of correctly articulated from misarticulated /s/ sounds within words. Omission of the phoneme, seven substitutions and four distortions of /s/ formed the basis for incorrect items in this phase. All were discriminable on the tape recorder. They were arranged from most audibly different (an omitted sound) to least audibly different from /s/ (a mild, slightly frontal /s/ distortion). Three initial /s/ words, three final /s/ words, three medial /s/ words, three /s/ blend words and two words containing two /s/ sounds were assigned to each error category.

For each item the child heard the same "word" twice, once correctly and once misarticulated. Pressing button number one was correct if word number one was correctly articulated, while pressing button number two was correct if the second word was correctly articulated.

Two types of gradual progression were built into this phase. The first type was the gradual progression from most obvious to most subtle type of misarticulation. In addition, within each misarticulated segment, the most discriminable items occurred first, *i.e.*, the first word had two /s/ sounds, both misarticulated. The final item in each segment also had two /s/ sounds; however, only one of them was misarticulated.

e. *Other considerations of the /s/ program*. A major difficulty in programming for discrimination of the sounds of a nonphonetic language is the intrusion of reading skill. This is especially true in constructing programs for use with new readers, who often seem entranced with the visual, rather than auditory, representation of words. For example, a child who can quickly say that "sear," probably an unfamiliar reading word, begins with /s/, will just as quickly say that "cereal" does not. This problem can be handled in two ways: One is to ignore those words with visual configurations that do not conform to their phonic properties. The other is to deal with it directly, and early, and to include such words systematically. Because of the large number of words in which a sound looks like "s" and sounds like /z/, looks like sh and sounds like /ʃ/, or looks like "c" and sounds like /s/, the latter course seemed mandatory. It is to be noted that such systematic manipulation appears often in the /s/ program.

This program differs from its prototype in some rather straightforward ways. The error analysis made of the original program served as the basis for item revision. In addition, some other changes were made. The most drastic of these was that Phase 1 was shortened considerably, while the transition task in Phase 3 was almost doubled in number of items. Further, the original program utilized only one male speaker. This program used both male and female voices.

2. The /z/ Program

a. *Constraints*. The most important constraints which English imposes on the format of the /z/ program is the small number of words beginning with /z/, the large number of words using /z/ in other positions, and the previously mentioned confusion of 's' grapheme and /z/ phoneme. The program reflects these constraints in its lengthened medial and final discrimination sections, its shortened initial one, its use of medial and final discriminations in other phases, and its systematic incorporation of /z/ words with "s" graphemes.

3. The /r/ Program

a. *Constraints*. The semi-vowel function of this phoneme posed one problem. It concerned the feasibility of treating /r/ and /ɝ/ with equivalence. It was felt that by so doing, without stressing their functional differences, a more general program for this sound could be written. The error analysis suggested that for tasks not involving position within words, this was feasible. However, positionality for the /ɝ/ was extremely difficult and was eliminated. For example, "earth" as an item involving correct and misarticulated productions was tenable; asking where the sound occurs in that word was not.

The second problem involved the many dialectical variations of /r/ in American English. The program uses a General American /r/ as the standard. Further, dialectical variations were rigidly avoided in Phase 4. Since approximately half of the subjects who used the program were Bostonians and half lived in Pittsburgh, it is felt that these decisions were justified by the data.

4. The /l/ Program

a. Constraints. This program, like /r/, used General American /r/ as standard, and again, dialectical variations were not used as distortions. Here, as with /r/, the split region sample appears to justify this decision.

5. The /g/ Program

a. Constraints. The many uses to which the grapheme "g" is put in English are systematically incorporated as wrong choices. For example, incorrect choices for items include through, thorough, cough, thought, gnome.

6. The /k/ Program

a. Constraints. Care was taken to insure that /k/ spelled "c," "ch," "qu," and "x" was included as well as incorporation of such words as "knife" as incorrect choices.

7. The /ʃ/ Program

a. Constraints. Again, orthographic confusion with 's' was of concern. In the case of the /ʃ/ phoneme, the problem was not as likely to cause confusion as with some others, because the sound is consistently written as "sh." The "tion" and "sion" problem medially was included.

8. The /f/ Program

a. Constraints. The /f/ phoneme, spelled as 'ph' and 'gh' was stressed. The number of distortions in Phase 4 was reduced because of the difficulty of distorting this phoneme. Another problem was that /f/ is one of the sounds most likely to pose discrimination problems related to the response characteristics of the tape recorder rather than the listener. The /f/-/θ/ distinction, for example, was quite difficult. In many instances, items were either rewritten or discarded because they could not be discriminated, once recorded, by the project staff.

9. The /ð/ Program

a. Constraints. The major constraint was length. The limited vocabulary forced either extreme item redundancy, or a very short program. A compromising course was taken. The program, however, has no section requiring that the number of /ð/ sounds in a given word be counted. This is because there are no English words having more than one /ð/.

10. The /θ/ Program

a. Constraints. A limited vocabulary interfered, although the problem with /θ/ was not as acute as with /ð/. Again, however, there is no section requiring the counting of /θ/ sounds in a word. The problem with /θ/-/f/ confusion was even more unfortunate here than with the /f/ program, because of the frequency with which /f/ is substituted for /θ/ in misarticulation.

11. General Differences Among Programs

a. While some effort was made to develop programs of roughly equivalent length, the frequency of occurrence of the sounds in question limited the effectiveness of the effort. This was often coupled with problems of familiarity of the words. When, for example, the investigator was casting about for more and more words with two /ʃ/ sounds, hit upon "Oshkosh," and became momentarily gleeful, a lesson was learned. The problem was to sample the widest reasonable range of examples for a sound, not to exhaust either a dictionary or a child's credibility.

Thus, programs differ in length. The differences reflect the frequency of usage of the sounds in English, however. Variation for Phase 4 also resulted from the number of substitutions and distortions typical for a given phoneme, as well as the recording speaker's capabilities in producing non-typical distortions. If there were fewer than twelve error sounds possible, the number of the usable error items used was increased accordingly, however.

Complete scripts of the ten programs can be found in Appendix A.

B. The Teaching Machine

The second objective of this demonstration was to develop fully automatic equipment for the presentation of these programs. Two machines were built to technical specifications; both were used simultaneously during the experiment. The teaching machine developed for this study presented the auditory problems (single words, pairs of words, isolated sounds) by tape recorder. The subject's response to an item was to press one of three buttons. If he responded correctly, a light located beside his response panel lit briefly, a counter in front of him advanced, and the tape recorder continued to play uninterrupted. If the subject's response was incorrect, the tape recorder immediately rewound and replayed the item. If he made a second error on that item, the tape recorder rewound and played the item preceding the missed item. If the child made no response at all to an item, the tape recorder rewound, and replayed the item.

The response panel, described briefly before, consisted of a thin aluminum box approximately 18" x 15" on the top of which were three large lucite buttons arranged in a horizontal row. These buttons were painted red, blue and yellow and identified by numbers and position. Color, number and position (beginning, middle and end) each served to control responding at some point in the program. When a button was not in use it could be removed. (This was done only with a few children who were retarded, and who were confused by the unused button.) In some parts of the program, the position of the buttons (beginning, middle and end) corresponded to the subject's task of identifying the beginnings, middles, and ends of words. In other parts, subjects used buttons 1 and 2 to indicate if these were one or two given sounds in a word. In the first phase, the program sound was identified as the blue button sound. All other sounds were red button sounds.

Two Tandberg tape recorders (monaural) which contained internal wiring for remote control operation was modified for this study. An extra playback head was incorporated into the machine. The extra playback head picked up coded signals recorded on a second track, and fed them to the control circuitry contained in a relay rack out of sight of the child. This circuitry controlled the forward play and rewind operations described above.

Tapes were prepared for use with this teaching machine on a Tandberg Model 74B (stereo) tape recorder. Three reed relays, each with a different frequency, generated the code signals which indicated the correct answer choice. These tones were fed directly into Channel Two of the tape recorder, and thus, recorded on the second track of the tape. The program was then recorded on Channel One. The output of Channel Two (the code) was simultaneously fed into a tone verifier. Lights corresponding to the reed relay tones lit as the tone came on, and furnished both a signal for recording an item and a check on the accuracy of the signal recordings.

A Gerbrands event recorder was wired into the teaching machine's control circuitry. The event recorder furnished a graphic record of the correct responses, the child's actual response, and the response latency.

C. Setting up the Teaching Room and Evaluating its Practicality

Because the project was moved in mainstream from Emerson College, Boston, Massachusetts to the University of Pittsburgh, Pittsburgh, Pennsylvania, two strategies for integrating the project into an ongoing clinical setting were evolved. The two clinics in question simply operated differently. Thus, two different patterns emerged.

Clinical facilities at Emerson College Robbins Speech and Hearing Center serve approximately 170 speech and hearing impaired persons weekly. During the time this project was at Emerson, roughly 80 undergraduate and graduate students in Speech Pathology and Audiology used this clinic for their major clinical practice experience. The investigator was a full-time member of the supervisory and teaching staff, and was given complete control over student clinicians participation in the project. In addition, a small room equipped with a one-way vision mirror facing into a large observation room was made available full-time to the project. This room had a small closet, next to it that was converted into space for housing the teaching machines' control apparatus.

When the machines were built and programs were available, all student clinicians assigned to articulation disorders practicum experience were called together, and the project was explained to them in detail. It was further explained to them that for the duration of any of their client's participation in the project, their role as the child's clinician would be changed. Instead of working directly with the child, their job was to observe the child while in session with the teaching machine. The result of each observation was a detailed written report of the child's behavior, an item analysis of the items he missed, etc. These reports were given to the project staff (one member of which was always present also) and evaluated for accuracy of reporting and general understanding of what the aims and goals of each programmed session were. These evaluations were incorporated into each student's final semester clinic practice grade. Clinical practice credit hours were given for this participation.

Every child in the clinic who misarticulated was evaluated by the staff for potential inclusion in the program. For children already in therapy, criteria for inclusion were: 1) that the child's unprogrammed speech sound discrimination training had either not been completed, or that pre-testing indicated that some discrimination problems still existed even if the clinician had completed that phase of clinical work; 2) that a program was available for a given child's misarticulation, 3) that the child was at least six years old. For six year old misarticulating children who were being seen for diagnosis in the regular clinic diagnostic periods, the pre-test battery was incorporated into the general diagnostic battery, and children for whom programs were available routinely began their clinic experience with the teaching machines. These new children had a clinician assigned also, and this clinician had a unique opportunity for detailed behavioral observation before beginning an actual clinical interaction. For the duration of each child's participation in the project, programmed sessions constituted a child's only clinical activity.

A word is in order concerning "available programs." An early decision was to begin the demonstration phase of the project as soon as one program was available, rather than to withhold use until all programs were complete. Thus early in the project, a child with a particular problem for which a program was projected but not yet developed was not included in the project. The project was explained to parents of the children who participated. They were encouraged to observe the sessions and to ask questions both of their child's clinician and the project staff. Only one parent objected to her child's participating and this was because she felt that her child did not have auditory discrimination problems, not because of the automated sessions. Her objections were countered by showing her her child's pre-program discrimination scores, and she reluctantly agreed to go along with the project. At the end of her child's participation, she was shown the post-test scores. Her child's marked improvement pleased her greatly, of course.

Each child in the project was initially shown the room, the apparatus, and taught to thread and operate the tape recorder and use the earphones. Since two machines were available, two children often were run simultaneously. When this occurred, they were introduced to each other, and it was explained to each that since they would be working on different things nothing would be gained from "comparing notes," etc. (In this regard it is interesting to note that no apparent rivalries for earning the most points, etc. evolved.) Each child was informed that for each point he earned (correct responses were totaled on his machine's counter) he would receive an M&M at the end of the session.

The inclusion of M&M's was the result of some initial observations of children's performance, rather than planned in advance. The first two subjects, partially because they were totally inexperienced in working in clinical speech situations alone, began by generating error rates which exceeded chance. It was decided to manipulate contingencies, rather than to rewrite the programs, in an attempt to bring down the rates. The counters were added. Error rates dropped, but were still excessively high. It was decided to include an extrinsic reinforcer, and M&M's, because they could be doled out in direct relationship to points earned, seemed to be a logical choice. When M&M's rather than points for their own sake were earned, error rates dropped precipitously. At that point, M&M's became part of the standard procedure.

Each child was encouraged to complete as much of a given program as he felt like at each session. He was, however, stopped when his time with the programs equalled the time of a regularly scheduled clinical session (around 45 minutes). This was partially because fatigue caused error rates to increase after much longer than this, but mostly because the demonstration operated within a tightly scheduled regular clinic program.

It should be pointed out here that some children assumed more than minimal responsibility for putting on tape, and settling themselves for work. For children who seemed interested, and/or capable of doing it, their routine jobs with the project included turning on the control equipment, clearing counters on both the control equipment and the teaching machine, and finding their own appropriate tapes (and thus remembering what they finished the previous week). Some of them were even allowed to count out and bag their own M&M's, if they could demonstrate that their counting rate exceeded their eating rate.

Other than the data itself, perhaps the two most interesting side-effects generated by the project at Emerson were the effect of the programmed sessions on student clinician performance, and the ease with which children accepted programmed training. The children's interest in the apparatus equalled the clinicians'; however, they adapted much more quickly to it, and were willing, even eager, to be responsible for operating it. An occasional breakdown intrigued them while it frightened and annoyed the clinicians. It was simpler to explain the control apparatus to the children, who were curious and unbiased about it than it was to the student clinicians, when histories in general had long ago convinced them that nothing electrical was understandable.

On the positive side, however, the clinician's growth in understanding of the nature of the programs and in accurate descriptions of their client's behavior was impressive. The opportunity for observing their clients, whom they knew well, particularly in a thoroughly planned and usually undeviating clinical experience, was excellent training for them. Further, it was frequently observed that after their client had finished the programs and with clients whose problems precluded involvement in the demonstration project, the clinician's behavioral observations were more accurate and their lesson plans more explicit.

The Speech Clinic at the University of Pittsburgh serves as a training clinic for graduate students in Speech Pathology. It differs from the Emerson Clinic primarily in that it is much smaller (it has roughly 20 student clinicians), and that most of the clinicians engaged in training there are considerably more experienced (they often have B.A. or M.A. degrees in Speech Pathology before entering the program at Pitt). Further, the space available for the project was considerably more limited. The response panels and tape recorders were located in one corner of a large room. The control apparatus was located in the opposite corner of the same room. In between were four desks which accommodated the research assistant for this project, a research assistant for another project, the principal investigator, and two research assistants for another investigator's project. No external observation room was available. These physical arrangements made observation by either clinicians or parents extremely difficult, and so was not encouraged except during those hours when the three extra desks were unoccupied. The investigator's control of the graduate student's participation was also limited by her lack of authority in the clinic and because she was only a part-time member of the departmental staff.

While none of these factors materially changed the children's role in the project, major alterations in integrating the project into the clinic resulted. The size of the clinic operation itself required the project to look outside for children who had articulation disorders. The two sources used were the Speech Clinic of Children's Hospital, Pittsburgh, Pennsylvania and the special services department of the Pittsburgh Public Schools, which furnished children for the project during the past summer.

The waiting-list for both diagnostic and clinical services at Children's Hospital was made available, and was screened for potential articulation disorder children. The director of that clinic, Mr. Lawrence Bloom, then wrote each parent, advising them of the project, and suggesting that they should take advantage of the program. Further, it was agreed that those children who completed programmed speech sound discrimination training would then be integrated quickly into the Hospital's case load. This turned out to be an extremely amicable arrangement for all involved.

The general policy of the Speech Clinic of the University is to concentrate on a variety of speech and language problems with which trained speech clinicians are less likely to have supervised experience, and to farm out its articulation disorder children to other facilities. There were, of course, some articulation problem children in the clinic. These children participated in the project in the manner outlined previously.

The Public Schools furnished children for summer work in discrimination training. A list of children, who would be receiving therapy later from the school's speech correctionists and who lived within easy commuting distance of the University, was compiled and made available. Parents were contacted by the project, and if they were interested, the children were diagnosed, pre-tested, and then, when appropriate, exposed to programs.

The role of the clinician, thus, differed markedly from Emerson to Pitt. In the case of the Public Schools, no contact at all was maintained. Our records were passed on, but no feedback to the project has ever resulted. In the case of Children's Hospital, the interest and conviction of the Director there resulted in a thorough exchange of information. Here, though, we were viewed as doing a professional job and interpreting ourselves professionally. The training potential and interchange was rightfully precluded by the nature of our relationship.

The experience within the Pitt clinic was also different from the Emerson experience. This was partially because of the autonomy of the graduate students which results from their usually rich backgrounds. It was also partially because students were not given clinical practice credit for participation in the project. The basic posture attributed to us was that we were involved in research; not training. The result of this was simply that students interested in research interested themselves in the project, and students interested in clinical management did not.

Because the principal investigator had no actual authority in clinic supervision, and because of space limitations it was impossible to involve students more completely. Moreover, it was believed that this contrast in approaches would enhance the generality of the project in terms of its potential usefulness in a variety of clinic and public school settings.

The data from Pittsburgh and Boston do not differ. It is impossible to tell which children were run where, except by subject number. This suggests that the value of the technique is not dependent upon the degree of training integration into the clinic operation.

Subjectively, however, it is felt that the value of the observation for the students' general clinical training was less comprehensive for Pitt students than it was for Emerson students. Perhaps this is because a majority of Pitt students, being at more advanced training levels than Emerson students, did not need it as much. However, since a number of Pitt students began to participate on their own and seemed to be reinforced enough to continue, it must be assumed that for them, at least, it was a valuable learning experience.

D. The Experimental Procedure

The basic experimental goal of this project was to evaluate the efficacy of programmed auditory discrimination training for improving discrimination of speech sounds in children who misarticulate. In order to make this evaluation, each child in the study was tested by a battery of tests designed to measure his general auditory discrimination skill and his discrimination of those specific consonants he misarticulated. These tests were administered before he began the programs and following his completion of the last available program pertinent to his problem.

In addition, because of the somewhat marginal information available concerning the effects of discrimination training *per se* upon articulatory skill, each child's general articulation was tested, as well as his articulation of consonants which appeared defective on the general tests. These measurements were made before and following each child's program exposure. For children who used more than one program, the specific post-tests appropriate to each program were administered following that program. Post-testing on the general battery followed completion of all appropriate programs.

Three discrimination tests and two articulation tests were thus routinely administered to each child. Each is described below.

1. The Discrimination Tests

a. *The Wepman Auditory Discrimination Test*. This is a 40-item word discrimination test that samples exhaustively the ability to discriminate among classes of consonants and vowels differing as to place, but not manner, of articulation (25). (For example, /k/ - /p/ discrimination is sampled. Both are plosives, differing in focal articulation point. Discrimination of /k/ - /s/ is not sampled, because they differ not only in regard to focal articulation point, but also as to manner of articulation, /s/ being a sibilant sound.) The Wepman Test was used in this study because it is relatively painless both to take and to give, because it has two equivalent forms, because it has published norms, and because it has been used as the measuring instrument in a number of studies investigating auditory discrimination skill in children. Form I was used as the preprogram measure; Form II was used as the postprogram measure. The child's score consisted of the number of items he missed. The test was tape recorded to achieve consistent discrimination items for all children. The child listened to a pair of words, reported aloud whether they were the same or different, and the experimenter wrote his response on the test form.

b. The Schiefelbusch-Lindsey Test. This 90-item discrimination test measures discrimination for rhyming words, nonrhyming initial sound position words, and final position sound discriminations. Each of these three classes of discriminations is further broken down to allow for the child's discrimination of another person's speech, the child's discrimination of his own speech, and the child's discrimination of his own "unmonitored" (or silent) speech. This test was included in the battery because of the variety of discrimination tasks it poses. Further, all of these tasks seem to be particularly appropriate in evaluating discrimination skill in children with defective articulation. The child's spoken response to each item was written on the test form by the experimenter. The child's score consisted of the number of items he missed. The test, necessarily, was presented live voice.

c. The Specific Discrimination Tests. Ten tests, one appropriate for each programmed sound, were constructed. Each test had 54 items that comprised discriminations similar to the most difficult items on each subsection of its program. These tests sampled discrimination of isolated phonemes, discrimination of positions of the sounds within words, counting the number of a given sound within a word and discrimination of correct incorrect sound production within words. The test items, while similar to the program's criterion items, were actually more difficult. Instead of a pair of words to be compared and evaluated as in over half of the program, test items consisted of single word presentations. Children who could write filled in their own responses on a test form. Children who could not write reported their answers aloud and the tester filled in the form. The child's score consisted of the number of items missed. The test was tape recorded for presentation.

2. The Articulation Tests

a. General Articulation Test. Each child's general articulation ability was assessed by a picture articulation test constructed for the study. The child was instructed to name each picture; the experimenter recorded if the sound tested by a given picture was correctly articulated, distorted, omitted or if another sound was substituted for it. The test sampled articulation of 24 consonants in appropriate initial, medial, and final positions, and 12 blends. The total number of items was 36. The child's score was the number of items he misarticulated.

b. The Specific Articulation Tests. An exploration of the child's ability to use his defective consonant sound in a variety of contexts was made. The instrument used was a specific test for each of the ten consonants. In each test, the consonant in question was combined with other consonants into initial, medial, and final consonant clusters. Pictures constituted the stimuli, as in the general test. Administration of the appropriate specific articulation tests followed the general articulation test. Which specific tests to administer was determined by performance on the general test. This test was scored using the 5 point rating scale for severity of misarticulation developed by Milisen (12). According to this scale, correct production receives a score of 1; a slight distortion is scored as 2; a severe distortion, 3; a substitution, 4; and an omission, 5.

3. The Subjects

Fifty-one articulation disorder children between the ages of 6 and 14 served as subjects. For purposes of this study, they satisfied no extremal criteria except that they were of school age and were either on a waiting list for or were receiving articulation correction. These children worked a total of 65 programs. That is, while most children worked through only one program, some used more. The maximum number of programs used by a single subject was four. The subject's I.Q. scores as reported in their clinical case folders ranged from 50 to 151. The I.Q. scores were normally distributed.

4. Reliability of the Examiners

Computation of discrimination test scores was made from the written records on each child. The articulation scoring, however, required the experimenters to make trained judgments about articulatory adequacy. Eight testers were used. In order to assure both inter and intra judge reliability concerning articulation judging, approximately half of the articulation tests (both general and specific) were tape recorded. These tape recorded tests were re-scored and percentages of agreement within and between testers were computed to assess both inter and intra judge reliability. Intra judge reliability ranged from 93 - 98%. Inter judge reliability was 91%.

III. RESULTS

Fifty-one school age children who had articulation disorders were given programmed auditory discrimination training appropriate to their misarticulations. Comparisons of scores from tests of discrimination for speech sounds and for articulation enabled evaluation of the effectiveness of programmed training. Similar analyses of specific speech sound discrimination programs were made in order to evaluate the effectiveness of each program. A third analysis of the data was made in order to measure the effectiveness of the training as a function of the age of the children who were exposed to the programs. All of these evaluations will be discussed separately below.

A. Cross-Program Comparison of Pre and Post Program Performances

1. Wepman Auditory Discrimination Test

Pre and post program performances on the Wepman Auditory Discrimination Test were compared, and evaluated statistically by a t test for matched groups. It will be remembered that the pre-test was Form I of the Wepman Test and the post-test was its equivalent form, Form II. Table 1 shows the mean error score, the difference between means, the standard error of the difference, and the t ratio. Inspection of this table shows a statistically reliable drop in error scores on the post program test.

TABLE 1

Comparison of Pre and Post Program Performance on Wepman Auditory Discrimination Test. Data Computed in Error Scores.

	Mean	Diff.	SEDiff	t*
Pre	8.02	3.62	.87	4.16
Post	4.40			

N = 50
t = .01 (df = 49) = 2.67

The mean number of errors dropped from 8.02 on the pre-test to 4.40 on the post-test. The mean change reflects improvement of 37 of the 50 children who were tested with this measure.

2. Schiefelbusch-Lindsey Discrimination Test

Pre and post program performance on the Schiefelbusch-Lindsey Test were compared and statistically evaluated by a t test for matched groups. These data are shown in Table 2. This table reports the mean error scores, the difference between these means, the standard error of the means, and the computed t ratio. This table shows a statistically significant drop in error scores on the post program test. The mean number of errors on the pre-test was 24.74; the mean post-test error score was 18.36. The mean drop in error scores reflects the performance of 43 of the 50 children tested.

TABLE 2

Comparison of Pre and Post Program
Performance on the Schiefelbusch-Lindsey
Discrimination Test. Data Computed in Error Scores.

	Mean	Diff.	SEDiff	t*
Pre	24.74	6.38	1.25	5.1
Post	18.36			

N = 50
t = .01 (df = 49) = 2.67

3. Schiefelbusch-Lindsey Test; Case-Monitored Subsection

One major deviation from traditional discrimination training which is made by programmed training is that children have no controlled opportunity to discriminate their own speech. A separate analysis of the case-monitored subsection of the Schiefelbusch-Lindsey Test was made, therefore, in an effort to assess if training was sufficient to produce changes in self-discrimination skills. This analysis was made by a t test for related measures. These data are reported in Table 3. It can be seen from this table that the mean error score on the pre-test was 7.60. The mean post-test error score was 5.80. The statistically reliable difference between these means reflects improvement in self-monitored discrimination for 40 of the 50 children tested.

TABLE 3

Comparison of Pre and Post Program Performance on the Case-Monitored Subsection, Schiefelbusch-Lindsey Test.

	Mean	Diff.	SEDiff	t*
Pre	7.60	1.80	.51	3.53
Post	5.80			

N = 50

t = .01 (df = 49) = 2.67

4. Discrimination for Specific Speech Sounds

Table 4 shows the changes in error scores on pre- and post-tests for discrimination of the specific consonant sounds for which children received programmed discrimination training. Scores on the tests, which were equivalent in length for each program are pooled here. The table shows means, the difference between means, the standard error of the mean and the t ratio. It can be seen from this table that the mean error score on the pre-test was 15.03; the post-test mean error score was 10.93. This mean difference of 4.10 is statistically reliable, and reflects the improved performance of 58 of 65 tests on specific consonant discrimination. (It should be pointed out here that the "65 tests" actually represent a total of 50 children, some of whom were exposed to more than one program and its appropriate pre- and post-tests.)

TABLE 4

Comparisons of Pre and Post Program Performance on the Sound Specific Discrimination Tests. Data Computed in Error Scores.

	Mean	Diff.	SEDiff	t*
Pre	15.03	4.10	.52	7.88
Post	10.93			

N = 65
t = .01 (df = 64) = 2.65

5. General Articulation

Pre- and post-test differences on the test of general articulation are shown in Table 5. The table reports means, the difference between means, the standard error of the mean and the computed t ratio. The data shown here represent each child's articulation (scored simply as correctly or incorrectly articulated) of those consonants for which he did not receive programmed training. The mean number of errors on the pre-test was 16.20; on the post-test, the mean number of errors was 12.98. The mean difference of 3.22 represented improvement in 37 of the 51 children tested, and was a statistically significant change.

TABLE 5

Comparisons of Pre and Post Program Performance on General Articulation Test. Data Computed in Error Scores. All Sounds for Which a Given Child Received Programmed Training are Excluded From the Analysis.

	Mean	Diff.	SEDiff	t*
Pre	16.20	3.22	1.02	3.16
Post	12.98			

N = 51
t = .01 (df = 50) = 2.67

6. Articulation of Specific Consonant Sounds for Which Children Received Programmed Instruction

It will be remembered that articulation of specific consonant sounds for which children received programmed instruction was measured using the 5 point scale of severity developed by Milisen. This scale, which postulates a hierarchy of articulatory deficit, classifies omissions as the severest form of articulatory deficit and hence scores an omission as 5. Substitution of another phoneme is regarded as next most severe, and is scored as 4; severe distortions are scored as 3; slight distortions are scored as 2; and, finally, correct production has a value of 1. Each child's articulation of the consonant sounds for which he received training was scored in terms of this scale on pre and post program tests of specific consonant articulation in a variety of phonetic contexts. Data from specific tests are pooled for this analysis. These data are shown in Table 6. The table reports means, the difference between means, the standard errors of the mean and the computed

TABLE 6

Comparisons of Pre and Post Program Performance on Specific Articulation Test. Scores Constitute Performance as Measured by Milisen's 5-point Rating Scale of Severity of Articulation Problems.

	Mean	Diff	SEDiff	t*
Pre	44.51	8.76	1.17	7.49
Post	35.76			

N = 65
t = .01 (df = 64) = 2.65

t ratio. The difference in pre- and post-test means reflect, thus, a decrease in severity of the presenting articulatory problem. The mean pre program test score was 44.51; the mean post program test score was 35.76. This decrease in severity reflects the performance of 58 of the 65 children thus tested. This decrease in severity is statistically reliable.

7. Summary of Pre- and Post-Test Scores Across Programs

Each of the pre and post program test scores, evaluated as to statistical significance by a t test, shows statistically reliable improvement as the result of programmed discrimination training. In effect, general auditory discrimination improved, as did discrimination of the sound that each child misarticulated. Misarticulation of the phoneme in question was also reduced in severity, and general articulation skill improved as well.

8. Analysis of Each Program

The preceding data analysis pooled the entire subject population and in general indicated the adequacy of programmed instruction for improving both articulation and discrimination skills. It does not, however, allow for any statements to be made concerning the effectiveness of each individual program. Therefore, each program was analyzed separately, in terms of pre and post program changes on the sound specific articulation test and on the sound specific discrimination tests. Because of the relatively small number of children who used each program, this analysis was done nonparametrically, by means of the sign test.

Computation for the sign test requires that unchanged scores (in this case pre and post program test scores which remained the same) be dropped from the analysis, and the N reduced correspondingly. Table 7, therefore, reports the total number of children who used each program, the number of untied pairs, the number of fewer pairs (in this case, children whose post-tests had more errors) and the appropriate associated probability. It can be seen from this table that five of the programs were used by too few children to allow for statistical comparison. (Indeed, two programs remain untested.) Of the five remaining programs, use of four of them appears to result in statistically reliable improvement. Only the /z/ program appears to be inadequate.

TABLE 7

Sound Specific Discrimination Test Score
Changes as a Function of Program Exposure

Program	Total N	N*	x**	P
s	17	16	3	.011
z	12	11	3	.113
r	15	14	1	.001
l	9	0	1	.020
ʃ	5	0	0	.031
k	3	0	0	---
g	1	0	0	---
f	3	0	0	---
θ	0	0	0	---
	0	0	0	---

*number of untied pairs
**x = number of fewer signs

Table 8 reports changes in articulation as it is related to exposure to each program. This table shows the total N, the number of untied pairs, the number of fewer signs and the appropriate probability. Again, five of the programs were used by too few children to allow for statistical evaluation. Of the five remaining programs, four of them appear reliably to effect a change in articulation only the /ʃ/ program does not reliably improve articulatory skill.

9. Analysis of Program Performance as a Function of Age

It is frequently suggested in articulation therapy literature that the improvement in articulation skill which appears to occur between the ages of six and seven is more probably the result of exposure to school than to speech correction (13). It was decided, therefore, to analyze the performance of these children as a function of age in order, first, to assess if the pattern appeared to hold true for programmed as well as unprogrammed

TABLE 8

Sound Specific Articulation Score
(Weighted Milisen Scale) Changes as
a Function of Program Exposure

Program	Total N	N*	x**	P
s	17	14	0	.001
z	12	9	0	.002
r	15	13	1	.002
l	9	7	0	.008
ʃ	5	5	1	.188
k	3	3	0	---
g	1	1	0	---
f	3	3	0	---
θ	0	0	0	---
ð	0	0	0	---

*number of untied pairs
**number of fewer signs

articulation therapy. In addition, assessment of program performance as a function of age might well furnish further insights into the question of whether an optimal age for programmed therapy might exist. Table 9 summarizes this analysis. The population was divided into arbitrary age groupings, and sign tests were done on articulation and discrimination scores for each age group. The number of children in each group, the number of children who completed more than one program, and the number of program exposures for each group are also tabulated. Examination of this table shows that the improvement was statistically significant for every group except the group under seven years of age.

10. Summary

In summary, every measure used in this study showed statistically significant post-test gains. Discrimination of specific consonants, general discrimination, articulation of specifid defective consonants and general articulation all improved. As a function of programmed speech sound discrimination training. The programs appear to be effective and reliable for children over seven years of age. As far as specific programs are concerned, the /z/ program appears to need major revisions in order to increase its reliability.

TABLE 9

Analysis by Age Groups

Under 7 years
Programs Used: [s, z, r, f]
N = 10
Children through two or more programs = 3
Program exposures = 13

	Total N	N*	x**	P
Sound-Specific Discrimination	13	9	1	.25
Sound-Specific Articulation	13	9	2	.09

7 year olds
Programs Used: [ʃ, z, r, l, s, f]
N = 15
Children through two or more programs = 5
Program exposures = 22

	Total N	N*	x**	P
Sound-Specific Discrimination	22	21	0	.001*
Sound-Specific Articulation	22	21	1	.001*

8 - 9 year olds
Programs Used: [s, ʃ, r, l, z, k]
N = 16
Children through two or more programs = 2
Program exposures = 18

	Total N	N*	x**	P
Sound-Specific Discrimination	18	15	1	.004
Sound-Specific Articulation	18	14	3	.001*

10 - 14 year olds
Programs Used: [s, g, z, l, r]
N = 10
Children through two or more programs = 2
Program exposures = 12

	Total N	N*	x**	P
Sound-Specific Discrimination	12	10	1	.01*
Sound-Specific Articulation	12	9	3	.001*

*number of untied pairs
**number of fewer signs

IV. DISCUSSION

The objectives of this demonstration project were to 1) develop a series of teaching machine programs for use on various consonant defects; 2) develop fully automated teaching machine equipment for administering the programs; 3) set up a clinic room with two such teaching machines; 4) administer the programs; and 5) evaluate the effectiveness of the programs.

Accomplishing the first four of these objectives was the crucial prerequisite for the fifth -- evaluation of the programs. Failure to develop programs and equipment would clearly have disallowed experimentation with them. Further, if it had not been possible to integrate this experiment into an ongoing clinical operation, evaluation of the programs would have been precluded. Since meeting these first four objectives has been described in detail in the methodology section, this discussion will focus upon the experimental aspects of the demonstration.

Auditory discrimination was the behavior to be trained by the programs, hence the discussion will begin with those findings bearing directly upon discrimination skills. Discrimination of specific consonant sounds will be discussed first. The other discrimination test results will be discussed next. The articulation findings will then be discussed in a similar specific-to-general-order. Following this, the programs' relative effectiveness and the role of age of the children who used them will be discussed and some general conclusions will be drawn.

A. Discrimination of Specific Defective Consonants

It seems clear from the data of this study that programmed auditory discrimination training is effective in improving that skill in children who misarticulate. These data confirm the findings of the earlier Holland-Matthews study on programmed training for discrimination of the /s/ phoneme (6), and extend them to include a number of other consonant-specific discrimination problems as well.

That discrimination of speech sounds can be improved by programmed instruction is not particularly surprising. The value of programmed instruction in training a number of other basic skills is well known. Since auditory discrimination is a skill which can be learned much like any other, adequate programs should be useful training devices. In fact, the techniques of programming seem uniquely relevant to changing discrimination skill. Good programs appear to have at least a theoretical advantage over the more traditional clinician in that they automatically allow for reinforcement. The clinician doing speech sound discrimination training has to function simultaneously as the speaker whose speech is discriminated, the evaluator, and the dispenser of reinforcement for correct responding. Repeated program tryouts result in an empirically evaluated, finely graded progression of items that allow for a high density of reinforcement. Clinicians must necessarily be more haphazard. Perhaps the most important basic advantage, though, is in the programmed procedure for establishing discriminations.

Adequate speech sound discrimination requires that the person be able to distinguish the sound in its full range of contexts. Such needs are characteristic of other situations that have been met in teaching machine work. It cannot be assumed that training in only a few "representative" cases in any training problem will lead to perfect transfer to the full range of cases. For this reason, an outstanding programming rule is to vary the examples over the widest possible range. The problem is somewhat similar to that found in concept formation. In establishing the concept of "redness" for example, many problems must be furnished, keeping "redness" constant in them, but combining it with a number of other properties. Good teaching machine programs rely heavily on such techniques.

This principle was used extensively throughout the programs. A number of other sounds were put in apposition to the programmed sound; the position of the programmed sound in words was systematically controlled and then systematically varied; a number of variations in misarticulation of the programmed sounds were used in varying phonetic contexts. One of the critical features of the programs was the wide range of examples used. The success of the programs in reducing discrimination deficits for misarticulated sounds suggests that effective discrimination training should incorporate such variety.

B. General Discrimination Skill

On both the Wepman and the Schiefelbusch-Lindsey tests, general discrimination abilities apparently improved as the result of training discrimination of a small number of (often only one) defective consonants. That is, the child whose /r/ discrimination improved as a result of discrimination training for /r/ would continue to show this improvement on those items of a general discrimination test involving /r/ discrimination. However, in a general test of discrimination, a child's programmed sounds constitute a relatively small number of the total sounds inventoried. The frequency with which the programmed sounds occur is low enough so that changes in them alone could not explain the magnitude of pre and past change in general discrimination skill. The most parsimonious explanation of this change appears to be that, as children were learning to discriminate a particular sound, their general listening behavior was concomitantly shaped. Some external justification for this interpretation comes from responses of parents who frequently reported to the project staff that their children's grades in phonics began to improve as a result of their training in discrimination. This raises the interesting experimental question of the efficacy of a general sound discrimination training program for use with pre-readers, or as basic phonics training in early reading. Such a program would, of course, be developed for children with no apparent discrimination or articulation deficit.

The Wepman Auditory Discrimination Test is published with norms indicating the number of errors that constitute "inadequate development" of discrimination skills as a function of age. Pre-program performance on the Wepman Test indicated that 19 of 51 children in this study showed no generalized discrimination deficit. Post-testing showed that 30 children had no generalized deficit. Thus, in addition to the statistically reliable drop in error scores, the performances of 11 children improved enough to bring their general discrimination abilities, as measured by the Wepman Test, within normal limits.

Changes on the Schiefelbusch Test reflect the same general improvement in discrimination skill, although the nature of the discrimination problems posed by this test are broader and apparently tap two additional discriminating functions, i.e., discrimination by the child of his own aloud speech, and his discrimination of his own silent speech. Because the programs do not arrange an opportunity for the child to discriminate his own speech, the separate analysis of the case-monitored subsection was made in order to assess if the training was sufficient to produce changes in self-discrimination skills. The statistically reliable change suggests that it is.

This change in self-discrimination skill is important in view of the discrimination behavior ultimately to be changed. If discrimination of one's own speech production can be changed by responding differentially to the speech of others, then clinical discrimination training for children who misarticulate can be considerably simplified, whether or not such training is programmed. These data indicate that it may be unnecessary to use the traditional exercises to teach the child to discriminate his own speech. The case-monitored subtest and the articulation results discussed below suggest that the child has already began to discriminate his own speech after, or during, effective discrimination training.

In a previous study using only an /s/ program, Holland and Matthews found clear differences in the /s/ sound discrimination but failed to find post-test changes on the Templin Test for speech sound discrimination, a general discrimination test. The discrepancy between these results and those of the previous study is probably related to two factors: 1) The general discrimination tests used in this study were more realistic and easier for the subjects to take. The Wepman, for example, has only 40 items, and words rather than nonsense syllables furnish the unit of measurement. The Schiefelbusch-Lindsey Test, especially, seems more related to real problems children with articulation disturbances are likely to possess, and samples discrimination ability quite widely. 2) The programs in this study were better. The present /s/ program, for example, is not exactly like the original one. The data for that program was used to revise and improve on it. The revision of the /s/ program served as the basis for the construction of the others, as well. Thus, improved programs and more sensitive tests were used in this study, and the improvement is doubtlessly related to both factors.

C. Specific Articulation

Changes in /s/ articulatory skill as a function of /s/ discrimination training were shown in the earlier study by Holland and Matthews. This result was cautiously interpreted as a change in the severity of the articulatory error. In the present study, articulation scores were computed using the Milisen scale of severity of articulation deficit (12). In the event that changes in articulation skills such as those obtained in the first study occurred in this study, quantification could thus be substituted for the interpretation.

Articulatory skill was again shown to improve as a function of effective discrimination training. What seems to have occurred, is that as discrimination improved, normal sound production was approximated. A substitution may become a distortion of the correct sound; a previously omitted consonant may now appear as a distorted one. Occasional correct phonemes may be produced. For four subjects, programmed training was sufficient to eliminate the articulation error completely. Through discrimination training, the child is made aware of the acoustic aspects of the sound and of the variety of phonetic contexts in which the sound occurs. As this awareness increases, so does automatic differential reinforcement for his correct or more nearly correct productions.

Holz and Azrin, in commenting upon the initial Holland and Matthews study make the point cogently:

> ... (The change in articulation) suggests another role of specific consequences in determining verbal behavior. Since the speaker is in one sense his own audience, the auditory stimuli arising from vocalizations act to control speech. Investigation of physical parameters of feedback ... have pointed to such factors as the intensity of sensory return as influential in determining the forcefulness (loudness) of speech. Furthermore, the delayed feedback experiments also point to the regulative effect of these response-produced stimuli. ...

> Apparently, discrimination of the proper sound is necessary for the response-produced sounds to reinforce proper articulation. (9)

There is remarkably little literature on the direct effects of discrimination training upon misarticulation. In a fairly recent study, however, Winitz and Bellerose (27), training children with defective /r/ sounds on a minimal pairs discrimination task, found no articulatory change as a function of their discrimination training. The apparent contradictory results of that study with the present one appears to be a result of three factors: 1) children's discrimination was trained on only one type of discrimination task rather than the variety of discrimination tasks used in this study, 2) training consisted only of extremely close discriminations without a preceding shaping procedure, 3) the number of trials required to reach criterion discrimination performance suggests that the discrimination, when finally established was not as efficient as it would have been if a training method geared to minimal error performance had been utilized. It would appear that these discrepant results are brought about because of procedural discrepancies. Additional support is thus furnished for the value of shaping a variety of auditory discrimination responses if articulatory change is desired.

D. General Articulation

The sounds for which a given child received programmed instruction were excluded from the analysis of his general articulation skills. This was done in order to assess the extent of the generalization that occurred as a function of training on specific discriminations. The small, but statistically reliable drop in error scores suggests that some general articulation improvement occurs. This is not particularly surprising; it is sometimes noted clinically that as a child begins to improve in articulation of one sound, another similar sound often shows improvement as well. What is interesting is that this change occurred in 37 children in the sample, and that it occurred as a function of discrimination, rather than production, training. The manner in which this improvement came about is perhaps best illustrated in the case of one child who completely overcame both frontally distorted /s/ and /z/ sounds while working through the /s/ program. She began with the /s/ program and was to use the /z/ program when she completed /a/ training. This child vocalized almost continually through the program and roughly three-fourths of the way through the program it became apparent that not only had her /s/ problem almost completely disappeared, but her /z/ problems on program items involving this phoneme were lessening too. By the end of the /s/ program, neither articulation error was present in her spontaneous speech repertoire.

A program's "incorrect" choices often involve other sounds with a high probability of concomitant misarticulation. Children with /s/ difficulty are likely to have difficulty with its voiced cognate /z/, and with other sibilant sounds as well. The /s/ program uses words with other sibilant sounds extensively as discriminatory items. Similarly, the /z/ program stresses sibilant discriminations as well, and so on. Additional practice is thus afforded in discrimination of other potentially defective sounds. This appears to pay off in minimal, but reliable, improvement of them as well.

E. Program Performance

There are two aspects of analysis of program performance that will be covered here: 1) the effectiveness of each program for changing sound-specific discrimination and articulation skills and 2) the effectiveness of programmed sound discrimination training as a function of age.

1. Programs

The /s/, /r/, /l/, and /ʃ/ programs were effective in producing reliable discrimination changes; the /s/, /z/, /r/, and /l/ programs were effective in producing reliable articulation changes. The small number of children who used the /k/, /g/, and /f/ programs did not permit statistical comparisons, although every child who used these programs improved. The /θ/ and /ð/ programs, while available, were simply not needed by this sample, and therefore, remain untested.

What generalizations can be made from these data? The most obvious is that in this particular sample of children articulation errors centered upon the consonants /s/, /z/, /r/, and /l/. (These are the most frequently misarticulated consonant sounds by most objective counts.) The programs developed for them, with the exception of the /z/ program, all appear to be effective for training discriminations.

The highest error rate was generated by the /z/ program. This clearly should have affected its usefulness. After-the-fact analysis of this program suggests that some crucial poor judgments were made in constructing it, and that its revision should compensate for its initial deficiencies. The fact that eight of the twelve children who used the program improved in discrimination and that nine of the children showed articulatory gain suggests that structural, rather than conceptual deficiencies are responsible for its problems. (It should be pointed out here that all programs used have been through a revision based on the data analysis. These revised programs rather than the original ones are included in the appendix.)

The program for /ʃ/, /k/, /g/, and /f/ have been used by a total of only eleven children. In general, the trend suggests that these programs are adequate for purposes of training discrimination. The final two programs, /ð/ and /θ/ remain unused, but are included in the appendix. They do not differ in format from the other programs, and it is a plausible assumption that their effectiveness will parallel the effectiveness of the other programs. The reason they were not used in this study is because no children with these problems appeared in the sample. No doubt some children somewhere have defective /ð/ and /θ/ sounds; it is quite possible, however, that the /ð/ and /θ/ programs could have more general practicality with speakers of non-standard dialects, where /θ/ and /ð/ problems are well known, and with speakers of English as a second language. Their effectiveness with both of these (adult) populations is a pertinent experimental question.

2. Program Use as a Function of Age

The children who participated in this study ranged in age from six to fourteen. In order to determine if the programs functioned similarly for each age level in the study, pre and post program performances on the specific discrimination and articulation tests were analyzed in terms of the ages of the subjects who used them. The data suggest that age is an irrelevant variable for children age seven or older. Age does not appear to influence error rate; and children above the age of seven appear to benefit from the programs. There were some subjective differences, however. The seven year olds appeared to be the most consistant performers. Although their data are not generally different from that of the older children, seven year olds appeared to enjoy the task most, and were most fascinated by the procedure, almost as though they were in a "discrimination readiness" phase. The eight year olds reflected some of this, too, although they were less exciting to observe. Older children, while performing adequately at times seemed almost blase and mechanical.

In contrast, the programs in their present form are probably inappropriate for six year olds. The six year olds made a disproportionate contribution to the error data; six year old performance with the /z/ program is responsible for its lack of statistical reliability. However, there were six year olds who improved. For example, one six year old was dismissed from the clinic after his second program. However, the general trend of the grouped data suggest the necessity of a basic program revision for these younger subjects.

Because the task and the machine were quite unfamiliar to the younger groups, this program revision must include a simple initial program phase in which the child is taught about the machine itself, and given some reinforcing basic listening experience. This early phase is somewhat analogous to the habituation and magazine training to which experimental psychologists routinely treat infra-human subjects; it is not unlikely that young human subjects should also respond well to a similar basic courtesy. Such an "habituation" task, it is felt, would contribute markedly to improved performance in younger subjects.

These data are consistent in indicating that programmed speech sound discrimination training is effective not only in reducing discrimination errors, but in reducing articulation errors, as well. Moreover, programmed discrimination training has some distinct advantages over more traditional forms of discrimination training. One fairly basic one is its efficiency. The average time spent with each program was three clinical sessions. During this time, the clinician theoretically could be free to work with other children, or to observe the fine grain effects of the child's performance with the program, etc. Not only is traditional discrimination training usually a longer process, but it is consuming of both student and clinician time.

A second advantage is the definable standard of quality a programmed clinical session can attain. Writing a program of this nature, even when the format is rather rigidly fixed, is a fairly meticulous exercise. For example, not only are the correct-response words carefully chosen, but the incorrect words take into account the distinctive features of the phonemes in question, and the frequencies of occurrence of the words; the "phonetic surround" of the sound in question is also carefully controlled. No word used was thrown in haphazardly; each was the result of a careful and concise and definable analysis. The average busy clinician can seldom afford the time to plan an individual session this carefully. The detailed records kept for error analysis, and the analysis itself, also reflect a kind of "quality control" which is a luxury in a typical clinic situation, regardless of the skill of the clinician.

Third, the method requires correct responding from the children before the program moves on. It is not a matter of educated guessing as to whether a child responds or not; (or if he responds correctly); it is impossible for the student to be passive; his participation is assured.

The fourth advantage is probably the most important of all. It relates not only to programmed instruction but to the far bigger area of behavioral analysis and operant clinical methodology. Built into the use of operant techniques are the assumptions that (1) before it is possible to change a given behavior it is necessary to specify it explicitly and (2) to effect change in behavior it is necessary to manipulate precisely the consequences of the behavior in question. In order to fulfill these assumptions, clinicians who use operant techniques must become astute observers and recorders not only of the behavior of their clients, but of their own as well. For such observation, data MUST be gathered, description MUST be separated from inference, fact MUST emerge from supposition. Of all operant techniques, this seems to come most simply with programmed instruction. Clinicians who take advantage of programmed instruction will find that they learn the value of systematic observation and data collection in the practice of speech correction. This alone is of great importance.

V. CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

It appears clear that programmed speech sound discrimination training is a feasible and useful technique for modifying both auditory discrimination and articulatory patterns in children who misarticulate. The experimental data of this research or demonstration project are consistent in showing that changes in auditory discrimination skills and in articulation follow from programmed training of this nature.

The demonstration aspects of this project involved using the programs and fully automated teaching machines to accomplish speech sound discrimination training in actual speech clinics. This project would suggest that integration of programmed speech correction into an ongoing clinic is not a particularly difficult task; parents and clinicians alike were enthusiastic and cooperative. This enthusiasm was directly related to the progress, in terms of changes in discrimination and in test scores, that resulted for almost every child in the project.

The major conclusions from this study are two: 1) discrimination of speech sounds are reliably improved by programmed instruction and 2) the data necessary to evaluate the instruction can be gathered in a clinical, rather than purely experimental, setting. This implies that experimental rigor, at least as it is related to programmed instruction, can be imposed with a minimum of difficulty on a clinical milieu.

Further, some interesting experimental questions have been raised as a result of this project. It is suggested that they furnish leads for other potentially fruitful applications of the principles of programmed instruction. Specifically, these are: 1) development of a pre-training technique for use with (both auditory and visual) discrimination training in young children; 2) development of discrimination programs for use with retarded children; 3) development of programs using a format somewhat similar to the auditory discrimination training programs, for teaching phonics; 4) use of these programs, especially programs for /ð/ and /θ/ with speakers of English as a second language.

It is felt that programs of the above nature have a high probability of successful application.

VI. SUMMARY

This report describes a two-year demonstration project in which ten teaching machine programs, appropriate for use with the ten most frequently misarticulated consonants, were written and used routinely with children who had articulation deficits and were being seen in speech clinics to overcome their articulation problems. The report discusses in detail: 1) the programs that were written; 2) the teaching machine that was developed for presentation of auditory frames and subsequent automatic presentation of response contingencies; 3) pre and post program discrimination and articulation performance; and 4) the use of automation in a speech clinic setting.

In general, the results of this study show statistically significant increases in both discrimination and articulation as a function of programmed discrimination training, and suggest that programmed instruction in a speech clinic is both feasible and useful.

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APPENDIX A

S Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /s/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /s/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /s/, push the red button when you hear any other sound.

1. s
2. s
3. tʃ
4. ɣ
5. s
6. ɣ
7. s
8. s
9. ʒ
10. s
11. f
12. s
13. f
14. ʒ
15. s
16. θ
17. s
18. ʃ
19. z
20. s
21. z
22. θ
23. ʃ
24. s
25. z
26. ʃ
27. s
28. θ
29. z
30. z
31. lateral (s)
32. s
33. s
34. lateral (s)
35. s
36. whistle (s)
37. s
38. whistle (s)
39. whistle (s)
40. s

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /s/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /s/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 lamp, word #2 sun -- you would push button #2 because sun begins with the /s/ sound. If I said word #1 sit, word #2 fly, you would push button #1 because sit begins with a /s/ sound. Don't worry about how to spell the words, just listen for the /s/ sound. Remember, push button #1 if word #1 begins with the /s/ sound. Push button #2 if word #2 begins with the /s/ sound. Listen for the beginning of the words.

1. sorry - large
2. beautiful - Saturday
3. city - into
4. night - slide
5. sidewalk - raccoon
6. add - sad
7. sore - car
8. seat - eat

Phase II A (Continued)

9. hawk - sock
10. mail - sail
11. bid - said
12. soon - noon
13. sandy - candy
14. in - skin
15. art - smart
16. spend - end
17. spell - yell
18. try - sky
19. sleigh - play
20. mile - smile
21. spring - ring
22. split - lit
23. slip - lip
24. park - spark
25. sled - led
26. spy - pie
27. cool - school
28. snow - no
29. view - soup
30. star - jar
31. sunny - funny
32. fight - sight
33. spin - chin
34. fine - sign
35. stem - them
36. sick - chick
37. scream - cream
38. wing - swing
39. strain - train
40. weep - sweep
41. sunflower - thick
42. safety pin - thump
43. salt - thunder
44. three - small
45. spray - thought
46. skirt - thread
47. theatre - sneeze
48. soap - throne
49. splash - thank
50. thorn - sparkle
51. zoo - seem
52. sleeve - zone
53. supper - zero
54. cent - shut
55. shoe - safe
56. sir - ship
57. shade - sailboat
58. shine - spoon
59. smell - should
60. show - soda
61. sugar - seed
62. throw - snow
63. sick - thick
64. some - thumb
65. threw - Sue
66. spot - thought
67. thread - spread
68. sank - thank
69. sing - thing
70. throne - stone
71. thump - stump
72. Sue - zoo
73. see - she
74. skip - ship
75. shell - spell
76. shade - snake
77. shovel - snuggle
78. skirt - shirt
79. shack - smack
80. shy - sigh
81. sheep - steep
82. stop - shop

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /s/ sound at the end of it -- the other will not. It is your job to decide which word ends with /s/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /s/ sound at the end. Remember if word #1 ends with /s/, push button #1. If word #2 ends with /s/, push button #2. Listen to the end sound.

Phase II B (Continued)

1. yes - no
2. kid - kiss
3. place - plate
4. boy - voice
5. learn - purse
6. print - press
7. bounce - town
8. top - talks
9. think - thanks
10. cakes - cape
11. peeps - deep
12. gets - met
13. cap - cats
14. pain - paints
15. cut - nuts
16. hates - wait
17. use - you
18. how - house
19. my - mice
20. loss - law
21. race - ray
22. lay - lace
23. eye - ice
24. niece - knee
25. one - once
26. books - book
27. gates - gate
28. racks - rock
29. bump - bumps
30. elephant - elephants
31. chipmonks - chipmonk
32. tulips - tulip
33. stamp - stamps
34. necks - north
35. breath - blouse
36. eats - teeth
37. cloth - cross
38. goose - booth
39. else - health
40. both - boats
41. bath - bats
42. mouth - mouse
43. moss - moth
44. force - fourth
45. shadow - doghouse
46. shepherd - perhaps
47. hoops - bush
48. jacks - rush
49. finish - prince
50. across - crush
51. trash - caps
52. face - flash
53. fence - fresh
54. dance - dash
55. mush - miss
56. puss - push
57. gas - gash
58. mess - mesh
59. leash - lease
60. shops - shot
61. has - grapes
62. ducks - as
63. police - please
64. plays - place
65. race - raise
66. buzz - bus
67. hiss - his
68. fox - fogs
69. rise - rice
70. once - ones
71. frocks - frogs
72. docks - dogs
73. seeds - seats
74. ropes - robes
75. pants - pans
76. lass - last
77. grasp - grapes
78. cats - cast
79. east - eats
80. past - pets
81. clasp - claps

Phase II C

Now you have listened for words that have a /s/ sound in the beginning and for words that have a /s/ sound at the end. If a word has a /s/ sound in it, but it is not at the beginning or at the end, we say that the /s/ sound is in the middle of the word. No matter where the /s/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: beside has a /s/ sound in the middle of it. Asleep has a /s/ sound in the middle of it. Fast has a /s/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /s/ sound in the middle of it, the other will not. It is your job to decide which word has the /s/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /s/ sound in the middle. Remember, if word #1 has a /s/ sound in the middle, push button #1. If word #2 has a /s/ sound in the middle, push button #2.

1. baseball - worry
2. goodbye - classroom
3. Easter - garden
4. heavy - icing
5. aside - ago
6. off - ostrich
7. gingerbread - gingersnap
8. wrist watch - river
9. insect - invite
10. ivory - ice cream
11. typing - testing
12. deny - decide
13. rooster - roomy
14. pasting - painting
15. handle - handsome
16. lobster - lollipop
17. untie - unseen
18. pigeon - Pittsburgh
19. master - magic
20. beside - before
21. answer - after
22. perfume - person
23. infant - instant
24. sister - teacher
25. soapsuds - elephant
26. passer - pitcher
27. brother - recess
28. oxen - another
29. lesson - leather
30. father - foster
31. also - although
32. usual - useful
33. measure - cancel
34. pleasure - placecard
35. tracer - treasure
36. blessing - everything
37. healthy - parcel
38. arithmetic - accident
39. anything - listening
40. nicely - nothing
41. basket - bath tub
42. panther - answer
43. something - saucer
44. master - machine
45. motion - mostly
46. baseball - bushel
47. fishing - fasten
48. iceberg - ocean
49. basket - bashful
50. ashamed - escape
51. kissing - cushion
52. wizard - whisper
53. sunset - sunshine
54. crazy - crisscross
55. dustpan - dozen
56. itself - daisy
57. desert - rooster
58. mistake - music
59. cousin - custard
60. western - Wednesday
61. Thursday - thirsty
62. racer - razor
63. dizzy - distant
64. lazy - lacey
65. east - easy
66. fuzzy - fussy

Phase Transition

Some of these words have one /s/ sound in them, some of them have two /s/ sounds in them. For instance, sometime has one /s/

sound in it. Snowsuit has two /s/ sounds in it. You are to listen carefully and decide how many /s/ sounds there are in a word. If there is one /s/ sound, push button #1. If there are two /s/ sounds, push button #2. Remember if you hear one /s/ sound, push button number 1; if you hear two /s/ sounds, push button number 2.

1. soup
2. soups
3. sinks
4. sink
5. slips
6. Christmas
7. socks
8. pussycat
9. sin
10. sincere
11. suck
12. sick
13. six
14. first
15. suffer
16. fistfight
17. sandbox
18. lollipops
19. circus
20. circle
21. haystacks
22. thanks
23. thoughts
24. thoughtless
25. steamboats
26. sash
27. sheets
28. swish
29. recess
30. ships
31. refreshments
32. zips
33. mistakes
34. season
35. sells
36. recites
37. see
38. seize
39. sunflowers
40. Suzy
41. seesaw
42. seasaws
43. icicles
44. eraser
45. erasers
46. mistress
47. mistresses
48. arrangements

Phase III

Now it is your turn to decide where the /s/ sound is. You will hear some words. Every word has a /s/ sound in it. You are to decide if the /s/ sound is in the beginning, the middle or the end of the word. If the word begins with /s/ like sun, push the beginning button. If the word ends with /s/ like bus, you push the end button. If the word has a /s/ sound somewhere between the beginning and the end of the word like asleep, push the middle button. Remember push the beginning button if the word begins with /s/, push the middle button if the word has the /s/ sound in the middle, and push the end button if the /s/ sound is at the end.

1. sack
2. inside
3. case
4. circle
5. decide
6. less
7. sell
8. silver
9. grass
10. palace
11. myself
12. listen
13. hospital
14. slide
15. castle
16. tops
17. scar
18. sprinkle
19. walks
20. absent
21. muscle
22. snap
23. dance
24. dancing
25. icing
26. ice
27. sleep
28. asleep
29. tax
30. taxi
31. stiff
32. fits
33. pass
34. past
35. last
36. lass
37. boats
38. boast
39. eats

Phase III (Continued)

40. east
41. cast
42. cats
43. fast
44. breakfast
45. this
46. smooth
47. that's
48. such
49. choice
50. chase
51. months
52. south
53. thinks
54. thistle
55. thanks
56. thumps
57. thirsty
58. earthquakes
59. thoughts
60. question
61. social
62. sash
63. shots
64. smash
65. shoestore
66. slush
67. sunshine
68. shops
69. snowshovel
70. shuts
71. shirts
72. seashore
73. seashell
74. ships
75. snowshoe
76. shapes
77. shoestand
78. dress
79. dresses
80. horses
81. horse
82. sees
83. season
84. upstairs
85. size
86. zips
87. presents
88. eskimos
89. snows
90. squeeze
91. serves
92. baseballs
93. Susan
94. roosters
95. strawberries

Phase IV

Now I'm going to say some more words to you. All of these words have a /s/ sound in them. I will say each word twice. One of the times I will use a good /s/ sound and one of the times I will not. If I use a good /s/ sound the first time, push the first button. If I use a good /s/ sound the second time, push the second button.*

1. Omitted (s)

sandbox
miss
absent
sing
yes
bicycle
vest
bounce
strong
box
blast
squeaks

2. Substitute (tʃ)

skates
sometime
snow
whisper
wants
speak
excellent
say
weeks
understand
possible
seesaw

---

*On first word of each group distort both /s/ sounds. On last word of each group distort _just_ first /s/.

Phase IV (Continued)

3. Substitute (t)

six
cereal
cups
Thanksgiving
class
lasso
spill
impossible
sweep
sox
circus

4. Substitute (ʒ)

pussycats
side
careless
fix
serve
face
dress
glasses
handsome
swim
soldier
snips

5. Substitute (ɬ)

since
kites
jumps
snip
possible
sink
sweater
race
popsicle
toaster
beanstalk
mistakes

6. Substitute (ʃ)

soups
advance
sorry
rice
pencil
yourself
looks
Eskimo
skip
acts
baskets

7. Substitute (z)

recess
salad
windowsill
upstairs
goose
stream
scare
toss
verse
pass
question
upsets

8. Substitute (θ)

spits
saucer
lights
hope
sandwich
rooster
seed
loss
whistle
instead
storm
exclaim
sense

Phase IV (Continued)

9. **Distort -- Snort**

states
so
fasten
muscle
sudden
principal
us
house
plaster
ax
split
crisscross

10. **Slight whistle**

snow suit
city
dancing
mouse
center
install
swell
address
ferris wheel
likes
keeps
boyscouts

11. **Distort - lateral (z)**

since
hate
sign
lifesaver
yesterday
December
blouse
backs
spinach
pasture
strawberry
escapes

12. **Slight frontal lisp**

princess
smallest
once
close
screen
string
drink
sorry
useful
whisper
gates
suit

R Program

Phase I

You are going to hear a lot of sounds, *one at a time*. When you hear a /r/ sound, push the blue button; *when you* hear any other sound, push the red button. For instance: /r/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /r/, push the red button when you hear *any other* sound.

1. r
2. r
3. dʒ
4. r
5. dʒ
6. r
7. r
8. tʃ
9. r
10. b
11. r
12. dʒ
13. r
14. r
15. s
16. f
17. w
18. r
19. w
20. r
21. w
22. j
23. r
24. l
25. j
26. l
27. r
28. r
29. w
30. r

Phase II A

I am now going to say some pairs of words. In every pair *one* of the words will have a /r/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /r/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 lamp, word #2 run -- you would push button #2 because run begins with the /r/ sound. If I said word #1 room, word #2 fly, you would push button #1 because room begins with a /r/ sound. Don't worry about how to spell the words, just listen for the /r/ sound. Remember, push button #1 if word #1 begins with the /r/ sound. Push button #2 if word #2 begins with the /r/ sound. Listen for the beginning of the words.

1. rat - bed
2. look - ride
3. raccoon - sidewalk
4. jumping - running
5. box - rock
6. recite - delight
7. romp - dump
8. boot - root
9. cake - rake
10. bob - rob
11. rash - sash
12. tent - rent
13. riddle - middle
14. rag - bag

Phase II A (Continued)

15. rule - tool
16. best - rest
17. rug - mug
18. season - reason
19. real - feel
20. rap - map
21. ran - man
22. muff - rough
23. hush - rush
24. rain - pain
25. sang - rang
26. mash - rash
27. teach - reach
28. ready - steady
29. rust - must
30. rice - twice
31. fight - right
32. rise - size
33. robin - bobbin
34. road - sewed
35. pocket - rocket
36. hush - rush
37. rose - those
38. twinkle - wrinkle
39. rope - hope
40. fun - run
41. yard - raid
42. roar - your
43. roll - yell
44. raw - yawn
45. you - room
46. rear - year
47. young - rung
48. yoke - wrote
49. radio - lady
50. liver - rivet
51. lead - red
52. road - load
53. low - row
54. rock - lock
55. read - lead
56. lace - race
57. wrong - song
58. waffle - rifle
59. wipe - rope
60. ring - wing
61. wait - rate
62. witch - rich
63. round - wound
64. ways - raise
65. write - white

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /r/ sound at the end of it -- the other will not. It is your job to decide which word ends with /r/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /r/ sound at the end. Remember if word #1 ends with /r/, push button #1. If word #2 ends with /r/, push button #2. Listen to the end sound.

1. car - bank
2. shave - razor
3. war - boy
4. clean - spear
5. water - castle
6. tear - sheep
7. favor - fail
8. few - for
9. pair - pain
10. math - more
11. another - animal
12. prepare - puppy
13. shovel - scooter
14. people - paper
15. fun - far
16. jar - jam
17. thunder - thumb
18. finger - thing

Phase II B (Continued)

19. melon - motor
20. sour - sound
21. pickle - pepper
22. never - next
23. sweater - sweet
24. near - neat
25. bean - bear
26. spider - speed
27. then - there
28. wear - whale
29. fire - fine
30. cage - care
31. young - your
32. handle - hammer
33. clear - clean
34. share - should
35. fussy - mother
36. most - motor
37. alright - alligator
38. feather - festival
39. picture - picnic
40. chase - chair
41. butter - button
42. teach - teacher
43. toaster - toast
44. sauce - saucer
45. stir - stay
46. kitchen - pitcher
47. under - kindle
48. truck - tractor
49. breakfast - before
50. sailor - sail
51. dinner - drum
52. hanger - hanging
53. program - propeller
54. roast - roaster
55. ruler - rule
56. four - free
57. farmer - farm
58. roar - rose
59. her - how
60. racer - races
61. rainbow - reindeer
62. singer - single
63. hour - cow
64. eagle - eager
65. bat - batter
66. snore - snow
67. were - warm
68. flower - flurry
69. farm - far
70. bird - purr
71. barn - bar
72. air - arm

Phase II C

Now you have listened for words that have a /r/ sound in the beginning and for words that have a /r/ sound at the end. If a word has a /r/ sound in it, but it is not at the beginning or at the end, we say that the /r/ sound is in the middle of the word. No matter where the /r/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: Berry has a /r/ sound in the middle of it. Train has a /r/ sound in the middle of it. Fruit has a /r/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /r/ sound in the middle of it, the other will not. It is your job to decide which word has the /r/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /r/ sound in the middle. Remember, if word #1 has a /r/ sound in the middle, push button #1. If word #2 has a /r/ sound in the middle, push button #2.

Phase II C (Continued)

1. afternoon - swimming
2. Sunday - arithmetic
3. barrel - stove
4. fence - bedroom
5. berries - funny
6. butterfly - sunshine
7. bicycle - camera
8. cast - careful
9. automobile - birthday
10. carrot - candy
11. celery - sell
12. charming - delicious
13. chase - cherry
14. cent - circle
15. cancel - circus
16. curtain - cushion
17. erase - each
18. anybody - everybody
19. fairies - families
20. fireplace - necklace
21. longest - largest
22. marbles - maples
23. many - marry
24. ocean - orange
25. church - choose
26. erase - each
27. feast - forest
28. ice cream - machine
29. icicle - ironing
30. candle - kangaroo
31. largest - longest
32. giraffe - gentle
33. skating - scaring
34. baker - barker
35. barrel - baffle
36. follow - farming
37. secret - select
38. pilot - parrot
39. parade - palace
40. hurrah - hula
41. forbid - folded
42. healing - hearing
43. golden - garden
44. narrow - shallow
45. firing - filing
46. tiring - towing
47. bowing - boring
48. morning - mowing
49. howling - horror
50. horses - houses
51. matching - marching

Phase Transition

Some of these words have one /r/ sound in them, some of them have two /r/ sounds in them. For instance, real has one /r/ sound in it. Railroad has two /r/ sounds in it. You are to listen carefully and decide how many /r/ sounds there are in a word. If there is one /r/ sound, push button #1. If there are two /r/ sounds, push button #2. Remember if you hear one /r/ sound, push button number 1; if you hear two /r/ sounds, push button number 2.

1. rock
2. railroad
3. bear
4. berry
5. rasberry
6. rain
7. raincoat
8. reindeer
9. rob
10. robber
11. run
12. running
13. remember
14. return
15. other
16. port
17. report
18. parrot
19. race
20. erase
21. eraser
22. wristwatch
23. river
24. roof
25. measure
26. strawberry
27. grandmother
28. razor
29. stairway
30. butterfly
31. cherry
32. cherries
33. grammar

Phase Transition (Continued)

34. near
35. wear
36. hamburger
37. winner
38. rubber
39. work
40. wire
41. wore
42. roar
43. orchard
44. arrow
45. gingerbread
46. mirror
47. library
48. early
49. earlier
50. rider

Phase III

Now it is your turn to decide where the /r/ sound is. You will hear some words. Every word has a /r/ sound in it. You are to decide if the /r/ sound is in the beginning, the middle or the end of the word. If the word begins with /r/ like run, push the beginning button. If the word ends with /r/ like car, you push the end button. If the word has a /r/ sound somewhere between the beginning and the end of the word like alright push the middle button. Remember push the beginning button if the word begins with /r/, push the middle button if the word has the /r/ sound in the middle and push the end button if the /r/ sound is at the end.

1. rocking
2. afternoon
3. beaver
4. rascal
5. around
6. star
7. result
8. ribbon
9. rover
10. hair
11. picture
12. marshmallow
13. turkey
14. bigger
15. radish
16. remind
17. surprise
18. better
19. our
20. wrap
21. carry
22. rectangle
23. rest
24. arrest
25. number
26. answer
27. thirsty
28. water
29. arithmetic
30. permit
31. ruby
32. squirrel
33. rust
34. wreath
35. barrel
36. fairy
37. fair
38. scar
39. scarf
40. turtle
41. race
42. fear
43. row
44. arrow
45. care
46. tear
47. terrible
48. wrong
49. gear
50. giraffe
51. chair
52. stared
53. row
54. war
55. were
56. word
57. race
58. erase
59. rectangle
60. stairway
61. woodpecker
62. organ
63. learn
64. learning
65. yard
66. yardstick
67. ear
68. hear
69. carton
70. car
71. army
72. birth

Phase IV

Now I'm going to say some more words to you. All of these words have a /r/ sound in them. I will say each word twice. One of the times I will use a good /r/ sound and one of the times I will not. If I use a good /r/ sound the first time, push the first button. If I use a good /s/ sound the second time, push the second button.*

Omitted

river
flower
room
bridge
door
carrot
ribbon
pair
hurt
letter
barn
dollar
gingerbread

Substitute (g)

terror
ring
our
parade
rascal
natural
pitcher
short
wearing
store
rope
raindrop

Substitute (n)

railroad
stairway
rear
door
through
short
whiskers
giraffe
wrinkle
rabbit
for
strawberry

Substitute (l)

rubber
sour
drum
picture
scream
ready
ring
sorry
around
dinner
start
remember

Substitute (j)

robber
around
robin
car
friend

Substitute (w)

raspberry
cherry
rat
dear
bring

---

[*] On first word of each group distort both /r/ sounds. On last word of each group distort just first /r/.

Phase IV (Continued)

squirrel
breakfast
kangaroo
grass
rug
hurray
story
read
berry
there
rare

three
grocery
rock
fire
park
freedom
umbrella
collar
farm
storm
pair
terrible
across
airplane
roar

Distort (between W-R)

reindeer
bring
terrible
smaller
kangaroo
carrot
door
sour
drink
disappear
leapfrog

Distort (dr)

razor
far
ribbon
pair
horse
sorry
rock
garden
through
bird
grocery

Distort (trill)

furniture
raccoon
forest
brown
your
mark
girl
picture
crack
truck
rice
orchard

Distort (French r)

return
right
art
propeller
fire
giraffe
barn
near
drip
wrinkle
rear

F Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /f/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /f/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /f/, push the red button when you hear any other sound.

1. f
2. f
3. l
4. f
5. b
6. f
7. f
8. p
9. p
10. f
11. f
12. b
13. f
14. p
15. f
16. f
17. ð
18. f
19. f
20. ð
21. p
22. f
23. f
24. θ
25. s
26. f
27. θ
28. f
29. f
30. v
31. f
32. θ
33. s
34. f
35. s
36. f
37. θ
38. f
39. v
40. f

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /f/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /f/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 fly, word #2 zoo -- you would push button #1 because fly begins with the /f/ sound. If I said word #1 zipper, word #2 forest, you would push button #2 because forest begins with a /f/ sound. Don't worry about how to spell the words, just listen for the /f/ sound. Remember, push button #1 if word #1 begins with the /f/ sound. Push button #2 if word #2 begins with the /f/ sound. Listen for the beginning of the words.

1. favorite - box
2. lollipop - flower
3. flashlight - Christmas
4. kangaroo - freedom
5. furniture - ice cream
6. baseball - football
7. forever - whoever
8. foolish - wish
9. mattress - factory
10. realize - fertilize

Phase II A (Continued)

11. morning - foreign
12. frozen - chosen
13. frost - crossroad
14. toward - forward
15. tight - fight
16. fold - told
17. fan - tan
18. tear - fear
19. firm - term
20. lamely - family
21. flower - lower
22. fruit - loot
23. filthy - wealthy
24. weather - feather
25. fish - wish
26. first - worst
27. wire - fire
28. fine - wine
29. alone - phone
30. forget - hornet
31. follow - hollow
32. harm - farm
33. fellow - hello
34. home - foam
35. five - hive
36. father - bother
37. full - bull
38. belt - felt
39. feed - bead
40. bus - fuss
41. fought - bought
42. felt - belt
43. fox - box
44. blame - flame
45. finish - punish
46. faint - paint
47. purr - fur
48. fair - pair
49. found - pound
50. pail - fail
51. pool - fool
52. feel - peel
53. for - pour
54. fort - port
55. that - fat
56. fair - their
57. thresh - fresh
58. thinker - finger
59. fin - thin
60. three - free
61. throne - phone
62. sore - forest
63. forty - sporty
64. storm - form
65. sorehead - forehead
66. fun - sun
67. same - fame
68. fled - sled
69. fine - sign
70. van - fancy
71. very - fairy
72. fat - vat
73. few - view
74. fast - vast
75. vault - fault
76. van - fan
77. vine - fine

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /f/ sound at the end of it -- the other will not. It is your job to decide which word ends with /f/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /f/ sound at the end. Remember if word #1 ends with /f/, push button #1. If word #2 ends with /f/, push button #2. Listen to the end sound.

1. sheriff - cowboy
2. dog - mischief
3. giraffe - nook
4. row - rough
5. why - wife
6. toe - tough
7. myself - raisin
8. chipmunk - enough
9. think - thief
10. stiff - stick

Phase II B (Continued)

11. spoof - spook
12. stuff - stuck
13. it - if
14. skit - skiff
15. cut - cuff
16. buff - but
17. chief - cheat
18. night - knife
19. last - laugh
20. loaf - low
21. life - lie
22. told - tough
23. old - oaf
24. woof - wood
25. mud - muff
26. half - had
27. safe - say
28. hoof - hood
29. skid - skiff
30. autograph - spiderweb
31. snuff - snub
32. riff - rib
33. tin - tiff
34. rough - rub
35. tub - tough
36. cliff - clip
37. cup - cuff
38. wife - wipe
39. strife - stripe
40. cap - calf
41. leap - leaf
42. snip - sniff
43. whiff - wish
44. gruff - grouch
45. punch - puff
46. couch - cough
47. beef - beast
48. sheriff - erase
49. flies - fluff
50. deaf - dress
51. grease (z) - grief
52. scarf - scars
53. leaf - lease
54. knife - nice
55. goose - goof
56. else - elf
57. chafe - chase
58. cuff - bathtub
59. enough - with
60. teeth - tough
61. truth - trough
62. oaf - oath
63. deaf - death
64. Ruth - roof
65. sheaf - sheath
66. breathe - brief
67. whiff - with
68. loaf - loathe
69. wreathe - reef
70. off - of
71. scarf - scarves
72. behalf - behave
73. prove - proof
74. half - have
75. relief - relieve
76. belief - believe

Phase II C

Now you have listened for words that have a /f/ sound in the beginning and for words that have a /f/ sound at the end. If a word has a /f/ sound in it, but it is not at the beginning or at the end, we say that the /f/ sound is in the middle of the word. No matter where the /f/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: rifle has a /f/ sound in the middle of it. Butterfly has a /f/ sound in the middle of it. Rooftop has a /f/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /f/ sound in the middle of it, the other will not. It is your job to decide which word has the /f/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /f/ sound in the middle. Remember, if word #1 has a /f/ sound in the middle, push button #1. If word #2 has a /f/ sound in the middle, push button #2.

1. lifetime - kangaroo
2. baseball - profession
3. breakfast - Sunday
4. cowboy - refreshments
5. playful - sandbox
6. soldier - different
7. portable - comfortable
8. bashful - beetle
9. safely - certainly
10. little - laughing
11. rattle - raffle
12. mutton - muffin
13. baffle - battle
14. comfort - airport
15. labor - lifesaver
16. roughly - bubbly
17. waddle - waffle
18. soda - sofa
19. prefer - prepare
20. sniffle - ripple
21. taffy - happy
22. riper - rifle
23. depend - defend
24. suffer - supper
25. shifting - shipping
26. after - either
27. rather - refer
28. offer - father
29. laughter - lather
30. dither - differ
31. firefly - wealthy
32. athlete - affect
33. ether - effort
34. author - office
35. prefer - panther
36. rooftop - Ruthie
37. effort - Ethel
38. ruthless - roofless
39. television - telephone
40. mouthful - measure
41. useful - usual

Phase Transition

Some of these words have one /f/ sound in them, some of them have two /f/ sounds in them. For instance, feel has one /f/ sound in it. Fluffy has two /f/ sounds in it. You are to listen carefully and decide how many /f/ sounds there are in a word. If there is one /f/ sound, push button #1. If there are two /f/ sounds, push button #2. Remember if you hear one /f/ sound, push button number 1; if you hear two /f/ sounds, push button number 2.

1. fair
2. french fries
3. ferriswheel
4. coffee
5. photo
6. photograph
7. fender
8. defender
9. awful
10. fan
11. fanfare
12. waffle
13. sheriff
14. cough drop
15. photo
16. fireman
17. flip flop
18. tough
19. fruit fly
20. fruitful
21. safety pin
22. tough
23. firefly
24. leaf
25. elephant
26. fish
27. fishfry
28. fishing
29. phone
30. telephone
31. phonograph
32. autograph
33. life
34. lifesaver
35. face
36. funnyface
37. feathers
38. fanfare
39. sourface
40. falseface
41. stuff
42. fulfill

Phase Transition (Continued)

43. fitful
44. forever
45. foolish
46. foodstuff
47. shuffle
48. fist
49. fistful
50. fist fight
51. fluffy
52. fluff
53. faith
54. faithful
55. thirty four
56. thief
57. alfalfa

Phase III

Now it is your turn to decide where the /f/ sound is. You will hear some words. Every word has a /f/ sound in it. You are to decide if the /f/ sound is in the beginning, the middle or the end of the word. If the word begins with /f/ like funny, push the beginning button. If the word ends with /f/ like calf, you push the end button. If the word has a /f/ sound somewhere between the beginning and the end of the word like traffic push the middle button. Remember push the beginning button if the word begins with /f/, push the middle button if the word has the /f/ sound in the middle and push the end button if the /f/ sound is at the end.

1. fun
2. coffee
3. laugh
4. fall
5. awful
6. off
7. fine
8. refine
9. after
10. puff
11. powder puff
12. elephant
13. cuff
14. cufflink
15. foolish
16. shelf
17. selfish
18. fish
19. flashlight
20. paragraph
21. wife
22. trough
23. lifesaver
24. life
25. face
26. safe
27. safety pin
28. softest
29. soft
30. fast
31. fasten
32. breakfast
33. staff
34. stuff
35. fuss
36. fussy
37. refuse
38. fuse
39. feet
40. giraffes
41. telephone
42. refresh
43. fresh
44. refreshment
45. flavor
46. favorite
47. favorites
48. enough
49. left
50. rough
51. ruffle
52. raft
53. rafts
54. fourth
55. flame thrower
56. thief
57. faith
58. thrift
59. thrifty

Phase IV

Now I'm going to say some more words to you. All of these words have a /f/ sound in them. I will say each word twice. One of the times I will use a good /f/ sound and one of the times I will not. If I use a good /f/ sound the first time, push the

Phase IV (Continued)

first button. If I use a good /f/ sound the second time, push the second button.[*]

Omit (f)

french fries
ruffles
puff
football
myself
elephant
frame
knife
scarf
flashlight
daffodil
phonograph

Substitute (l)

forty-four
muffin
sheriff
film
fact
stuff
safety pin
mischief
telephone
cliff
fellow
faithful

Substitute (ʃ)

fifty-four
before
muff
myself
roughly
fry
fate
afternoon
life

Substitute (k)

frightful
beautiful
brief
frozen
giraffe
afternoon
playful
rough
lifesaver
flight
theif
fifteen

Substitute (b)

falseface
leaf
offer
frame
sunflower
goof
buff
free
scuffed
farther
shuffle
fifty

Substitute (p)

fanfare
effective
loaf
flat
calf
microphone
ferriswheel
different
sniff

---

[*] On first word of each group distort both /f/ sounds. On last word of each group distort just first /f/.

Phase IV (Continued)

coffee
fish
fife
frost
prefer
flavorful

Substitute (ɣ)

fluff
traffic
tough
feet
paragraph
perfume
scarf
feather
coughing
bashful
gruff
forty-five

Substitute (s)

flat foot
chief
finish
office
half
laughter
felt
sniff
flag
proof
lifeboat
firefly

Substitute (θ)

photograph
puff
waffle
freeze
enough
grief
after
fast
fog
rifle
brief
fruit fly

Substitute (v)

alfalfa
furniture
ruffle
flea
wife
beef
infect
finish
refreshment
behalf
cough
fifty

Distort (mild)

flip flop
favorite
muffler
if
lofty
fringe
cufflink
self
off
form
finish
foodstuff

Distort (severe)

fluffy
grapefruit
often
truthful
elf
flip
rafter
fudge
effect
frog
fantastic
fitful

L Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /l/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /l/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /l/, push the red button when you hear any other sound.

1. l
2. l
3. m
4. l
5. u
6. l
7. r
8. u
9. l
10. b
11. j
12. l
13. l
14. r
15. u
16. l
17. j
18. l
19. r
20. l
21. l
22. au
23. l
24. au
25. j
26. au
27. l
28. l
29. l
30. w
31. l
32. au
33. l
34. w
35. distort (l)
36. l
37. l
38. w
39. distort (l)
40. l

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /l/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /l/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 lamp, word #2 zoo -- you would push button #1 because lamp begins with the /l/ sound. If I said word #1 zipper, word #2 lady, you would push button #2 because lady begins with a /l/ sound. Don't worry about how to spell the words, just listen for the /l/ sound. Remember, push button #1 if word #1 begins with the /l/ sound. Push button #2 if word #2 begins with the /l/ sound. Listen for the beginning of the words.

1. lion - baby
2. hot dog - letter
3. lamb - hat
4. lemon - question
5. lake - ache
6. east - least
7. own - loan
8. moose - loose

Phase II A (Continued)

9. looking - cooking
10. lunch - crunch
11. lip - dip
12. choose - lose
13. give - live
14. lot - hot
15. blizzard - lizard
16. lazy - hazy
17. half - laugh
18. letting - getting
19. lariat - chariot
20. loon - spoon
21. spice - lice
22. lend - spend
23. leap - sleep
24. slow - low
25. lumber - slumber
26. slice - lice
27. least - feast
28. line - fine
29. fog - log
30. light - flight
31. loot - flute
32. limb - thin
33. theater - leader
34. lot - thought
35. lick - thick
36. theft - left
37. link - think
38. latch - thatch
39. thief - leaf
40. rising - license
41. leak - reap
42. locker - rocker
43. race - lace
44. rain - lane
45. rung - lung
46. ladder - rather
47. limb - rim
48. river - liver
49. long - wrong
50. law - raw
51. lucky - you
52. yank - lift
53. yard - lard
54. least - yeast
55. yearn - learn
56. yacht - lot
57. losing - using
58. yet - let
59. yes - less
60. young - lung
61. lawn - yawn
62. loaf - wood
63. weaken - least
64. lesson - western
65. wiggle - legal
66. link - wink
67. wife - life
68. leather - weather
69. lay - way
70. went - lent
71. lead - weed
72. whip - lip
73. wine - line
74. lie - why
75. wet - let
76. leaving - weaving
77. wed - led
78. weep - leap
79. wake - lake
80. lagging - wagging

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /l/ sound at the end of it -- the other will not. It is your job to decide which word ends with /l/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /l/ sound at the end. Remember if word #1 ends with /l/, push button #1. If word #2 ends with /l/, push button #2. Listen to the end sound.

Phase II B (Continued)

1. doorbell - hotdog
2. music - whistle
3. giggle - grapefruit
4. sandal - sandbox
5. pirate - purple
6. bathtub - bubble
7. apron - April
8. miserable - misery
9. pull - pond
10. turkey - turtle
11. automatic - automobile
12. camel - camera
13. popeye - popsicle
14. spinach - spindle
15. body - bottle
16. hospital - doctor
17. angle - anchor
18. terror - terrible
19. door - doll
20. fool - fur
21. bicycle - rider
22. pepper - pebble
23. poor - pool
24. saddle - sadder
25. car - call
26. fail - fair
27. pickle - picker
28. meal - mere
29. far - fall
30. weaver - weevil
31. more - mole
32. sample - sampler
33. pail - pair
34. out - owl
35. seashore - seashell
36. ball - bar
37. tower - towel
38. girdle - girder
39. eagle - eager
40. tire - tile
41. brow - boil
42. cow - kill
43. Nell - now
44. rile - row
45. pow - pull
46. chow - shall
47. sell - sow
48. howl - how
49. player - football
50. angel - legion
51. lease - seal
52. final - laughing
53. missile - listen
54. pool - loop
55. elbow - wobble
56. tail - late

Phase II C

Now you have listened for words that have a /l/ sound in the beginning and for words that have a /l/ sound at the end. If a word has a /l/ sound in it, but it is not at the beginning or at the end, we say that the /l/ sound is in the middle of the word. No matter where the /l/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: yellow has a /l/ sound in the middle of it. Flower has a /l/ sound in the middle of it. Balloon has a /l/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /l/ sound in the middle of it, the other will not. It is your job to decide which word has the /l/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /l/ sound in the middle. Remember, if word #1 has a /l/ sound in the middle, push button #1. If word #2 has a /l/ sound in the middle, push button #2.

Phase II C (Continued)

1. hello - donut
2. away - welcome
3. balloon - cookies
4. fast - silly
5. school bus - anxious
6. feather - dollar
7. mice - violet
8. allowing - amazing
9. mellow - meadow
10. paper - paleface
11. handkerchief - halo
12. magic - mailbox
13. baloney - banana
14. really - racket
15. recite - polite
16. false - face
17. washing - waltzing
18. foghorn - follow
19. tulip - horseshoe
20. July - junior
21. sailor - raindrop
22. perish - publish
23. horrid - hollow
24. follow - forest
25. seldom - sorry
26. alarm - around
27. garden - golden
28. bellow - borrow
29. early - every
30. border - boulder
31. solo - sorry
32. fearing - feelings
33. purse - pulse
34. very - valley
35. pilot - pirate
36. clean - cream
37. brew - blue
38. free - flea
39. broom - bloom
40. clock - crock
41. plop - prop
42. grew - glue
43. Nebraska - Alaska
44. relapse - rewraps
45. coward - collar
46. relate - reward
47. seaweed - ceiling
48. relay - roadway
49. William - wigwam
50. awake - asleep
51. molar - lower
52. wayward - welcome
53. tolling - towing
54. onion - unless
55. taller - tower
56. forewarn - forelorn
57. palace - powder
58. canyons - candles
59. doubting - dally
60. howling - Howard
61. walrus - wall
62. sell - celery
63. felt - fell
64. roll - rolled
65. fault - fall
66. goal - gold
67. shell - shelf
68. mild - mile
69. slim - swim
70. sleeper - sweeper
71. left - felt
72. rally - Larry

Phase Transition

Some of these words have one /l/ sound in them, some of them have two /l/ sounds in them. For instance, measles has one /l/ sound in it. Lollipop has two /l/ sounds in it. You are to listen carefully and decide how many /l/ sounds there are in a word. If there is one /l/ sound, push button #1. If there are two /l/ sounds, push button #2. Remember if you hear one /l/ sound, push button number 1; if you hear two /l/ sounds, push button number 2.

Phase Transition (Continued)

1. like
2. likely
3. pail
4. hill
5. hillbilly
6. lilac
7. lie
8. umbrella
9. balloon
10. milk
11. lonely
12. alone
13. looking glass
14. looking glasses
15. allowed
16. loudly
17. lollipop
18. lady
19. landlady
20. salt
21. school girl
22. flashlight
23. flash
24. marshmallow
25. ladle
26. willy-nilly
27. wool
28. owl
29. lawless
30. handlebar
31. lowly
32. folk tale
33. whirlpool
34. wheelbarrow
35. wolf
36. wolves
37. flannel
38. flannels
39. willow
40. yearly
41. loyal
42. loyally
43. yellow
44. jelly roll
45. royally
46. royal
47. little
48. lower
49. flower
50. wildly
51. believe
52. believable
53. unbelievable
54. Philadelphia
55. talcum powder

Phase III

Now it is your turn to decide where the /l/ sound is. You will hear some words. Every word has a /l/ sound in it. You are to decide if the /l/ sound is in the beginning, the middle or the end of the word. If the word begins with /l/ like look, push the beginning button. If the word ends with /l/ like ball, you push the end button. If the word has a /l/ sound somewhere between the beginning and the end of the word like believe push the middle button. Remember push the beginning button if the word begins with /l/, push the middle button if the word has the /l/ sound in the middle and push the end button if the /l/ sound is at the end.

1. lady
2. believe
3. mail
4. cereal
5. marshmallow
6. lemon
7. lemonade
8. alone
9. lone
10. only
11. fall
12. falling
13. all
14. also
15. fellow
16. fell
17. let
18. letter
19. tall
20. lot
21. bubble
22. leap
23. asleep
24. long
25. belong
26. purple
27. lay
28. alley
29. alligator
30. lawyer
31. child
32. children
33. ill
34. pill
35. pillow
36. glum
37. lump
38. pole
39. tadpole
40. cantalope
41. lizard
42. blizzard
43. lag
44. flag
45. listen

Phase III (Continued)

46. glisten
47. glass
48. sell
49. blouse
50. louse
51. easel
52. easily
53. bottle
54. lighthouse
55. slight
56. rail
57. railroad
58. roll
59. rollerskate
60. learn
61. ladybird
62. early
63. earlier
64. curl
65. curly
66. lurk
67. will
68. willing
69. while
70. wily
71. wild
72. wool
73. wolf
74. glowing

Phase IV

Now I'm going to say some more words to you. All of these words have an /l/ sound in them. I will say each word twice. One of the times I will use a good /l/ sound and one of the times I will not. If I use a good /l/ sound the first time, push the first button. If I use a good /l/ sound the second time, push the second button.*

Omit (l)

level
valley
lesson
squeal
gallon
whistle
special
leap frog
hotel
telephone
lucky
general
taller
school bus
flashlight

Substitute (ɣ)

lily
stencil
collar
like
quarrel
blue
handle
glove
wheelbarrow
miracle
seagull
elephant
ugly
lung
jellyroll

Substitute (j)

lonely
hello
lark
feel
black
silk

Substitute (r)

table cloth
watermelon
lunch
flake
less
turtle

---

*On first word of each group distort both /l/ sounds. On last word of each group distort just first /l/.

Phase IV (Continued)

polliwog
flip
football
final
golden
bowling
lame
middle
lollipop
shallow
flood
island
steering wheel
tassle
California
rattling
pull
police
leather
delight
lately

Substitute (w) (final becomes almost ɔ)

little
balance
loaf
meal
please
tunnel
color
play
ball
jello
longer
collect
rustler
school
unleash
noodle
windowsill
unbelievable

Distort (underwater l)

wholesale
outlaw
library
beautiful
platoon
title
melody
flat
ideal
silly
lame
alphabet
sail
diesel
willy-nilly

Distort (l-d)

lordly
elsewhere
lion
mechanical
blend
cancel
relax
gloomy
evil
unless
lean
windmill
squirrel
bullet
ladle

Distort (glottal l)

lonely
alike
least
farewell
climate
rifle
collapse
foolish
original
elevator
lumber
coal
solution
plug
flannel

K Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /k/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /k/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /k/, push the red button when you hear any other sound.

1. k
2. k
3. f
4. k
5. k
6. l
7. r
8. h
9. tʃ
10. k
11. k
12. k
13. tʃ
14. k
15. d
16. d
17. k
18. d
19. p
20. k
21. k
22. p
23. k
24. p
25. k
26. k
27. ŋ
28. k
29. t
30. t
31. k
32. t
33. t
34. k
35. k
36. g
37. k
38. g
39. g
40. k

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /k/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /k/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 kiss, word #2 boy -- you would push button #1 because kiss begins with the /k/ sound. If I said word #1 hay, word #2 car, you would push button #2 because car begins with a /k/ sound. Don't worry about how to spell the words, just listen for the /k/ sound. Remember, push button #1 if word #1 begins with the /k/ sound. Push button #2 if word #2 begins with the /k/ sound. Listen for the beginning of the words.

1. careful - snow
2. father - cowboy
3. kiss - farm
4. foot - key
5. come - lesson
6. leave - cave
7. qualify - lemon
8. camera - log

Phase II A (Continued)

9. light - kite
10. lamb - clam
11. yawn - calm
12. canary - man
13. cover - mover
14. moth's - clothes
15. mission - cushion
16. kind - mind
17. carry - marry
18. ham - can
19. kindle - handle
20. heap - creep
21. queer - hear
22. coffee - jiffy
23. camel - jumble
24. jeep - keep
25. crab - jab
26. claw - jaw
27. join - coin
28. cool - jewel
29. chill - castle
30. Christmas - children
31. queen - chain
32. chatter - clatter
33. careful - cheerful
34. chum - crumb
35. keys - cheese
36. crime - chime
37. crew - chew
38. chow - cow
39. cane - chain
40. kneel - call
41. kill - know
42. climb - knife
43. college - knowledge
44. dog - conceal
45. comb - dumb
46. common - diamond
47. did - kick
48. cream - dream
49. collar - dollar
50. dandy - candy
51. dear - queer
52. canary - dairy
53. cries - dries
54. cousin - dozen
55. palace - carload
56. cancel - pencil
57. piano - canoe
58. passing - kissing
59. came - pain
60. pearly - curly
61. punch - crunch
62. proud - crowd
63. clay - play
64. clump - plump
65. page - cage
66. quarter - porter
67. telephone - carriage
68. kick - pick
69. kitchen - touching
70. tunnel - kennel
71. turtle - kernel
72. crunch - trench
73. quack - track
74. climb - time
75. tried - cried
76. toast - coast
77. tight - kite
78. cold - told
79. call - tall
80. table - cable
81. tea - key
82. cock - talk
83. cannon - gallon
84. goose - course
85. garage - courage
86. glove - clove
87. could - good
88. guard - card
89. colder - golden
90. crumble - grumble
91. glass - class
92. glue - clue
93. crow - grow
94. crate - great
95. gave - cave

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /k/ sound at the end of it -- the

Phase II B (Continued)

other will not. It is your job to decide which word ends with /k/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /k/ sound at the end. Remember if word #1 ends with /k/, push button #1. If word #2 ends with /k/, push button #2. Listen to the end sound.

1. haystack - farmer
2. summer - unhook
3. flock - bunny
4. monk - money
5. snow - snowflake
6. hoe - hook
7. milk - mill
8. tall - talk
9. stick - still
10. mistook - mister
11. bank - band
12. work - word
13. rod - rock
14. made - make
15. layed - lake
16. speak - speed
17. brink - brim
18. listen - lick
19. alone - alike
20. pink - pin
21. bark - barn
22. thin - thick
23. wasp - walk
24. musk - map
25. help - hawk
26. trick - trap
27. look - loop
28. soak - soap
29. rap - rack
30. chip - chick
31. lick - lip
32. shock - shop
33. raise - rake
34. look - loose
35. worse - work
36. mask - mass
37. cloth - clock
38. toothache - toothbrush
39. smack - smash
40. dish - disk
41. lounge - lack
42. dodge - dock
43. risk - ridge
44. sink - singe
45. lunge - luck
46. bridge - brick
47. fork - forge
48. ache - age
49. hitch - homesick
50. ink - inch
51. pitch - pick
52. wick - witch
53. snack - snatch
54. break - bracelet
55. boot - book
56. sack - sat
57. sick - sit
58. park - part
59. dart - dark
60. hark - heart
61. cheat - cheek
62. like - light
63. rock - wrong
64. bang - bank
65. sank - sang
66. rang - rank
67. wink - wing
68. think - thing
69. pollywog - tomahawk
70. brick - brag
71. snack - snag
72. lock - log
73. dug - duck
74. wick - wig
75. leak - league

Phase II C

Now you have listened for words that have a /k/ sound in the beginning and for words that have a /k/ at the end. If a word has a /k/ sound in it, but it is not at the beginning or at the end, we say that the /k/ sound is in the middle of the word. No matter where the /k/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: monkey has a /k/ sound in the middle of it. Package had a /k/ sound in the middle of it. Looking has a /k/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /k/ sound in the middle of it, the other will not. It is your job to decide which word has the /k/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /k/ sound in the middle. Remember, if word #1 has a /k/ sound in the middle, push button #1. If word #2 has a /k/ sound in the middle, push button #2.

1. eskimo - baseball
2. straw - tinker
3. twinkle - twilight
4. selfish - section
5. popsicle - popeye
6. palace - package
7. seeing - seeking
8. recline - reline
9. charcoal - charming
10. buoyant - boy scout
11. lining - liking
12. money - monkey
13. pickel - pimple
14. drinking - dribble
15. absent - accent
16. fixing - fibbing
17. obey - okay
18. hockey - hobby
19. riddle - wrinkle
20. flicker - fiddler
21. looking - loading
22. knocking - nodding
23. speeder - speaker
24. occur - odor
25. explain - airplane
26. snicker - snipper
27. choppy - chalky
28. circle - purple
29. oxen - open
30. acid - accept
31. inkwell - engine
32. midget - secret
33. adjourn - acorn
34. badger - baker
35. bucket - budget
36. doctor - dodger
37. mischief - flicker
38. punching - pumpkin
39. watched - wicked
40. picture - pitcher
41. section - session
42. waiting - baking
43. uncle - until
44. turkey - turtle
45. frosty - friskey
46. walker - water
47. mustard - musket
48. packing - patting
49. rocking - rotting
50. certain - circus
51. racks - rats
52. spring - sprinkle
53. hanky - hanger
54. wringer - wrinkle
55. sinking - singing
56. anchor - anger
57. engage - escape
58. excellent - eggshell
59. raccoon - dragon
60. ashcan -afghan
61. eagle - equal
62. beacon - begun

Phase II C (Continued)

63. logger - locker
64. backing - bagging
65. ankle - angle
66. climbing - recline
67. accompany - company
68. quarter - awkward
69. drinking - clinging
70. breaking - creating
71. package - cabbage
72. kitchen - chicken

Phase Transition

Some of these words have one /k/ sound in them, some of them have two /k/ sounds in them. For instance, kiss has one /k/ sound in it. Cake has two /k/ sounds in it. You are to listen carefully and decide how many /k/ sounds there are in a word. If there is one /k/ sound, push button #1. If there are two /k/ sounds, push button #2. Remember if you hear one /k/ sound, push button number 1; if you hear two /k/ sounds, push button number 2.

1. kiss
2. workbook
3. crisscross
4. crossing
5. cracked
6. cracker
7. crack
8. crawl
9. cook
10. crook
11. crooked
12. clocked
13. locked
14. locker
15. clerk
16. candle
17. candlestick
18. apricot
19. apricots
20. microscope
21. magic
22. magical
23. complicate
24. complication
25. complete
26. complex
27. complement
28. elect
29. election
30. technique
31. technical
32. tax
33. taxi
34. taxicab
35. echo
36. quick
37. quill
38. quiet
39. quite
40. quack
41. quake
42. extra
43. excellent
44. extract
45. clog
46. clogged
47. kindergarten
48. boxing gloves
49. Greeks
50. creeks

Phase III

Now it is your turn to decide where the /k/ sound is. You will hear some words. Every word has a /k/ sound in it. You are to decide if the /k/ sound is in the beginning, the middle or the end of the word. If the word begins with /k/ like kiss, push the beginning button. If the word ends with /k/ like hike, you push the end button. If the word has a /k/ sound somehwere between the beginning and the end of the word, like monkey, push the middle button. Remember push the beginning button if the word begins with /k/, push the middle button if the word has the /k/ sound in the middle and push the end button if the /k/ sound is at the end.

Phase III (Continued)

1. key
2. baker
3. work
4. sink
5. ice cream
6. color
7. neck
8. coffee
9. raccoon
10. crown
11. cross
12. whiskers
13. drink
14. ache
15. request
16. breakfast
17. stake
18. take
19. taken
20. come
21. income
22. count
23. recount
24. honk
25. honks
26. kiss
27. kisses
28. quart
29. quarter
30. back
31. backs
32. six
33. sick
34. mix
35. mixer
36. fix
37. fixes
38. tack
39. tax
40. quit
41. squash
42. squeeze
43. slick
44. scratch
45. screen
46. quaint
47. excellent
48. excite
49. cupboard
50. bracket
51. blackboard
52. brook
53. dike
54. codfish
55. awkward
56. yardstick
57. carpenter
58. pelican
59. chipmunk
60. caterpiller
61. pogo stick
62. cage
63. jacket
64. magic
65. jack-o-lantern
66. stagecoach
67. catch
68. chick
69. chicken
70. choir
71. require
72. crunch
73. chocolate
74. screech
75. bucket
76. kitchen
77. tomahawk
78. king
79. cling
80. marketing
81. drinking
82. kangaroo
83. cargo
84. glee club
85. garlic
86. rectangle
87. gigantic
88. Thanksgiving
89. photographic

Phase IV

Now I'm going to say some more words to you. All of these words have a /k/ sound in them. I will say each word twice. One of the times I will use a good /k/ sound and one of the times I will not. If I use a good /k/ sound the first time, push the first button. If I use a good /k/ sound the second time, push the second button.*

---

*On first word of each group distort both /k/ sounds. On last word of each group distort _just_ first /k/.

Phase IV (Continued)

Omitted (k)

workbook
coffee
duck
pussycat
cannon
mistake
boy scout
trick
kitten
walks
skirt
crisscross

Substitute (d)

crackerjack
capful
basket
stock
pelican
book
kitchen
popsicle
look
quiet
kindergarten
cake

Substitute (d)

technique
ice cream
cowboy
kiss
circus
chipmunk
sparkle
accident
neck
brook
case
complex

Substitute (b)

candlestick
comb
captain
beanstalk
snake
fork
turkey
excellent
cardboard
magic
dark
craker

Substitute (p)

crooked
chocolate
come
cotton
snake
yardstick
breakfast
truck
squirrel
company
elastic
quake

Substitute (tʃ)

taxicab
crayon
take
ask
tricycle
color
accept
chick
cape
twinkle
fox
microscope

Phase IV (Continued)

Substitute (t)

quack
cat
scatter
brook
thumbtack
queen
curtain
smack
trick
kept
quite
technical

Distort - Snort

quick
snowflake
eskimo
kindle
alike
speaker
toothache
canary
knocking
carriage
crime
cackle

Distort - Gutteral

excavate
homesick
thick
kernel
musket
clump
bucket
tomahawk
cousin
dock
wrinkle
cookie

Substitute (g)

clerk
cup
because
sock
spark
overcoat
creep
drink
secret
clean
quarter
complex

Distort - Glottal Stop

clock
inkwell
park
coin
doctor
carload
mask
homesick
oxen
pumpkin
careful
extract

G Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /g/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /g/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /g/, push the red button when you hear any other sound.

1. g
2. g
3. z
4. r
5. g
6. dʒ
7. g
8. dʒ
9. m
10. g
11. g
12. g
13. t
14. g
15. t
16. t
17. g
18. b
19. b
20. g
21. g
22. ŋ
23. g
24. ŋ
25. g
26. g
27. d
28. d
29. g
30. d
31. g
32. g
33. d
34. k
35. g
36. k
37. g
38. k
39. k
40. g

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /g/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /g/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 gas, word #2 lion -- you would push button #1 because gas begins with the /g/ sound. If I said word #1 house, word #2 game, you would push button #2 because game begins with a /g/ sound. Don't worry about how to spell the words, just listen for the /g/ sound. Remember, push button #1 if word #1 begins with the /g/ sound. Push button #2 if word #2 begins with the /g/ sound. Listen for the beginning of the words.

1. gardener - sheriff
2. feather - gum
3. given - zebra
4. halloween - goblin
5. goat - rope
6. river - ghost
7. grape - ape
8. growl - owl
9. listen - glisten
10. haze - gaze
11. release - geese
12. guess - mess

Phase II A (Continued)

13. gush - mush
14. yard - guard
15. year - gear
16. gutter - putter
17. gave - pave
18. prayer - glare
19. glad - plaid
20. prove - groove
21. golden - balloon
22. gladly - boldly
23. gather - bother
24. best - guess
25. guide - bride
26. gun - bun
27. blew - grew
28. gloom - bloom
29. gnat - get
30. groom - gnome
31. gallon - jello
32. jaunt - gauze
33. grumpy - jumpy
34. juice - goose
35. guilt - jilt
36. gust - just
37. get - jet
38. jab - grab
39. grocery - tall
40. fall - groceries
41. governor - telephone
42. gasoline - trampoline
43. gopher - trophy
44. talent - gallant
45. green - tree
46. gown - town
47. trip - grip
48. greet - treat
49. guessed - test
50. tied - guide
51. garnish - tarnish
52. diamond - gamble
53. gorgeous - dangerous
54. group - troop
55. dime - grime
56. gleam - dream
57. drew - glue
58. drove - grove
59. gloom - doom
60. dumb - gum
61. drain - grain
62. drape - grape
63. guy - die
64. gaily - daily
65. doe - go
66. gull - dull
67. cannon - gallon
68. goose - course
69. garage - courage
70. clove - glove
71. crawl - growl
72. game - came
73. good - could
74. guard - card
75. kill - gill
76. cold - gold
77. crow - grow
78. grumble - crumble
79. glass - class
80. clue - glue
81. crate - great
82. gave - cave

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /g/ sound at the end of it -- the other will not. It is your job to decide which word ends with /g/. It it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /g/ sound at the end. Remember if word #1 ends with /g/, push button #1. If word #2 ends with /g/, push button #2. Listen to the end sound.

1. dog - she
2. railroad - icebag
3. unclog - warm
4. house - thug

Phase II B (Continued)

5. umbrella - backlog
6. raisin - plague
7. plug - summer
8. favor - vague
9. way - wag
10. snag - snail
11. intrigue - enter
12. handbag - handle
13. water - waterlog
14. ham - hamburg
15. washcloth - washrag
16. iceberg - ice cream
17. underdog - underneath
18. firefly - fireplug
19. shag - shape
20. hog - hop
21. cop - cog
22. chump - chug
23. lap - lag
24. mug - lobe
25. hub - hug
26. snug - snub
27. nag - nab
28. stag - stab
29. drab - drag
30. wallet - birdog
31. fog - foot
32. clog - clot
33. sat - sag
34. pig - pit
35. bet - beg
36. Meg - met
37. kept - keg
38. dialogue - orange
39. nutmeg - nudge
40. huge - hug
41. large - league
42. budge - bug
43. log - lodge
44. jug - judge
45. wage - wag
46. bridge - brig
47. leg - ledge
48. rig - ridge
49. bag - badge
50. vogue - food
51. raid - rag
52. wig - wide
53. mug - mud
54. rogue - rode
55. sad - sag
56. beg - bed
57. dig - did
58. pollywog - tomahawk
59. break - brag
60. dog - dock
61. eek - egg
62. log - lock
63. drug - drunk
64. tuck - tug
65. wig - wick
66. leak - league
67. fig - fling
68. peg - pang
69. tongue - tug
70. lug - lung
71. log - long
72. bag - bang
73. spring - sprig
74. brig - bring
75. bowleg - bowling
76. snug - snuggle
77. smuggle - smug
78. bug - buggy
79. lagged - lag
80. jagged - jag

Phase II C

Now you have listened for words that have a /g/ sound in the beginning and for words that have a /g/ sound at the end. If a word has a /g/ sound in it, but it is not at the beginning or at the end, we say that the /g/ sound is in the middle of the word. No matter where the /g/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: cigar has a /g/ sound in the middle of it. Tiger has a /g/ sound in the middle of it. Forget has a /g/ sound in

Phase II C (Continued)

the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /g/ sound in the middle of it, the other will not. It is your job to decide which word has the /g/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /g/ sound in the middle. Remember, if word #1 has a /g/ sound in the middle, push button #1. If word #2 has a /g/ sound in the middle, push button #2.

1. cigar - vanilla
2. traffic - wagon
3. figure - animal
4. hammer - dragon
5. doughnut - doghouse
6. weighing - wagging
7. neighing - nagging
8. fragrant - freight
9. evergreen - ever
10. rained - ragged
11. reset - regret
12. journal - jungle
13. seagull - seal
14. magazine - maypole
15. wimper - wiggle
16. sugar - super
17. flopping - flogging
18. ripen - rigor
19. organ - open
20. linger - limper
21. trigger - tripper
22. table - tangle
23. umbrella - ungraceful
24. ago - elbow
25. carbon - cargo
26. signal - symbol
27. soggy - sobby
28. degree - debris
29. vital - vigor
30. antler - anger
31. tiger - tighter
32. bigger - bitter
33. barter - bargain
34. beetle - beagle
35. regal - retell
36. regain - retain
37. average - vinegar
38. fidget - forget
39. lounging - lugging
40. magnet - magic
41. pigpen - pigeon
42. fudgy - foggy
43. loyal - legal
44. begger - badger
45. lodger - logger
46. bugged - budged
47. adore - argue
48. organize - ordinary
49. magazine - medicine
50. cider - cigar
51. finger - fiddler
52. hundred - hungry
53. bigger - bidder
54. muddy - muggy
55. ogre - odor
56. ugly - uncle
57. escape - engage
58. eggshell - excellent
59. ashcan - afghan
60. begin - beacon
61. foxy - foggy
62. become - begun
63. sinker - single
64. fickle - figure
65. eagle - equal
66. rigger - wrinkle
67. locker - logger
68. hanker - haggard
69. decree - degree
70. ankle - angle
71. anger - anchor

Phase Transition

Some of these words have one /g/ sound in them, some of them have two /g/ sounds in them. For instance, grass has one /g/ sound in it. Organ-grinder has two /g/ sounds in it. You are to listen carefully and decide how many /g/ sounds there are in a word. If there is one /g/ sound, push button #1. If there are two /g/ sounds, push button #2. Remember if you hear one /g/ sound, push button number 1; if you hear two /g/ sounds, push button number 2.

1. green
2. geiger counter
3. organ-grinder
4. gravy
5. hog
6. hogged
7. ground hog
8. groundling
9. grounded
10. egg
11. eggnog
12. eggs
13. segregate
14. segment
15. gigle
16. gig
17. wig
18. wigwam
19. wigwag
20. gollywog
21. pollywog
22. grasshopper
23. gap
24. gag
25. pig
26. pigpen
27. guinea pig
28. pegleg
29. grab
30. grabbed
31. grab bag
32. brag
33. braggart
34. gargle
35. garbage
36. gas
37. gaslight
38. gargantua
39. gadget
40. gauge
41. garage
42. gargoyle
43. gang
44. gangrene
45. girl
46. gurgle
47. gurgling
48. hurdy gurdy
49. kangaroo
50. catalogue

Phase III

Now it is your turn to decide where the /g/ sound is. You will hear some words. Every word has a /g/ sound in it. You are to decide if the /g/ sound is in the beginning, the middle or the end of the word. If the word begins with /g/ like girl, push the beginning button. If the word ends with /g/ like dog, you push the end button. If the word has a /g/ sound somewhere between the beginning and the end of the word like tiger, push the middle button. Remember push the beginning button if the word begins with /g/, push the middle button if the word has the /g/ sound in the middle and push the end button if the /g/ sound is at the end.

1. gay
2. cigar
3. hog
4. wag
5. seagull
6. gear
7. rug
8. saga
9. slug
10. ghetto
11. golf
12. signal
13. gush
14. gallop
15. league
16. ugly
17. argue
18. monologue
19. guzzle
20. tongue
21. intrigue

Phase III (Continued)

22. ago
23. go
24. snug
25. snuggle
26. begun
27. gun
28. buggy
29. bug
30. group
31. regroup
32. braggart
33. brag
34. smuggle
35. smug
36. regard
37. guard
38. plug
39. lug
40. lugged
41. grill
42. pollywog
43. grape
44. bagpipe
45. pogo
46. plague
47. chug
48. grouch
49. together
50. iceberg
51. toboggan
52. tugboat
53. guidebook
54. jug
55. garbage
56. engage
57. luggage
58. jig
59. jiggle
60. grudge
61. gorgeous
62. gigantic
63. nutmeg
64. waterlog
65. tollgate
66. pigtail
67. congratulate
68. totebag
69. argument
70. goddess
71. goodness
72. bird dog
73. drug store
74. disregard
75. dialogue
76. going
77. bragging
78. gathering
79. greetings
80. sleeping bag
81. chewing gum
82. grafting
83. clogging
84. digging
85. gong
86. Greek
87. cargo
88. keg
89. kangaroo
90. garlic
91. rectangle
92. catalogue
93. colleague
94. agriculture

Phase IV

Now I'm going to say some more words to you. All of these words have a /g/ sound in them. I will say each word twice. One of the times I will use a good /g/ sound and one of the times I will not. If I use a good /g/ sound the first time, push the first button. If I use a good /g/ sound the second time, push the second button.*

Omitted (g)	Substitute (p)
gollywog	grab bag
game	regular
gush	gold
foggy	plague
rag	engage
iceberg	gallop
trigger	nutmeg
hamburg	gripe

---

*On first word of each group distort both /g/ sounds. On last word of each group distort just first /g/.

Phase IV (Continued)

green
forget
magazine
eggnogg

Substitute (b)

gargantua
gave
magnet
slug
wig
target
cigar
gather
goblin
jigsaw
icebag
goggles

Substitute (ð)

segregate
ground
golden
muggy
hunger
brag
dug
grill
grape
tug
intrigue
geiger counter

Substitute (d)

gargantua
trigger
garnish
fig
groove
stag
dog house
growl
vinegar
vague
pigpen
gag

dialogue
snug
neglect
gurgle

Substitute (dʒ)

pegleg
anger
garbage
fireplug
punching bag
finger
guide
gorgeous
penguin
rug
gold
ground hog

Substitute (t)

giggling
chug
league
gush
gigantic
gull
monologue
washrag
forget
gutter
regret
congregate

Substitute (k)

gargoyle
gaze
underdog
begin
gallon
grandfather
pollywog
eggshell
gossip
drug
toboggan
guinea pig

Phase IV (Continued)

Substitute (ŋ)

- wigwag
- soggy
- wiggle
- leg
- tugboat
- drag
- linger
- ragged
- vigor
- kangaroo
- agriculture
- gangrene

Distort snort

- good grief
- good
- tiger
- eagles
- Greek
- jug
- together
- frog
- dragon
- sag
- fig
- gurgling

Distort glottal stop

- organ grinder
- grumble
- legal
- bugle
- wag
- smug
- grief
- gate
- log
- plug
- sugar
- gargle

Distort gutteral

- green grass
- gone
- organ
- tag
- handbag
- regular
- guitar
- garden
- figure
- frog
- saga
- pegleg

/ʃ/Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /ʃ/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /ʃ/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /ʃ/, push the red button when you hear any other sound.

1. ʃ
2. ʃ
3. g
4. v
5. ʃ
6. f
7. ʃ
8. ʃ
9. f
10. ʃ
11. z
12. θ
13. ʃ
14. ʃ
15. f
16. ʃ
17. s
18. θ
19. ʃ
20. s
21. ʃ
22. z
23. ʃ
24. ʒ
25. ʃ
26. ʃ
27. ʒ
28. s
29. ʃ
30. tʃ
31. tʃ
32. s
33. ʃ
34. ʃ (distort)
35. ʃ (distort)
36. ʃ
37. tʃ
38. ʃ
39. ʃ (distort)
40. ʃ

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /ʃ/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /ʃ/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 shoe, word #2 bat -- you would push button #2 because shoe begins with the /ʃ/ sound. If I said word #1 table, word #2 shake, you would push button #2 because shake begins with a /ʃ/ sound. Don't worry about how to spell the words, just listen for the /ʃ/ sound. Remember, push button #1 if word #1 begins with the /ʃ/ sound. Push button #2 if word #2 begins with the /ʃ/ sound. Listen for the beginning of the words.

1. shadow - girl
2. butterfly - shaft
3. Sharon - train
4. walk - shoehorn
5. shriek - eat
6. older - shoulder
7. share - air
8. Shirley - early
9. ark - shark
10. loot - shoot

Phase II A (Continued)

11. game - shame
12. sharp - harp
13. shear - pier
14. river - shiver
15. dirt - shirt
16. shrewd - crude
17. shuffle - muffle
18. hop - shop
19. shrimp - valley
20. vacate - shave
21. show - vote
22. shawl - vault
23. shrine - vine
24. vowel - shall
25. she - V
26. shortstop - found
27. five - shy
28. shade - faith
29. flabby - shabby
30. shower - flower
31. shad - fad
32. four - shore
33. shout - thimble
34. third - sheriff
35. shut - thud
36. sherbert - thirsty
37. shrink - think
38. thank - shank
39. sheaf - thief
40. thin - shin
41. shrew - threw
42. shamrock - zebra
43. shield - zeal
44. zone - shown
45. shell - jello
46. should - judge
47. jack - shack
48. sheep - jeep
49. shelter - sailboat
50. spoon - shrink
51. separate - shepard
52. shovel - snuggle
53. shampoo - soda
54. shopping - stopping
55. sift - shift
56. shelf - self
57. stock - shock
58. snowman - showman
59. short - snort
60. chain - shrivel
61. chalk - shoelace
62. chance - shotgun
63. shape - change
64. shine - chime
65. chip - ship
66. shrill - chill
67. chatter - shatter

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /ʃ/ sound at the end of it -- the other will not. It is your job to decide which word ends with /ʃ/. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /ʃ/ sound at the end. Remember if word #1 ends with /ʃ/, push button #1. If word #2 ends with /ʃ/, push button #2. Listen to the end sound.

1. finish - clean
2. tomahawk - eyelash
3. stylish - style
4. children - childish
5. tickling - ticklish
6. fevery - fererish
7. foolish - fooling
8. publish - public
9. polish - polite
10. rabbit - radish
11. refresh - regret
12. wand - wash
13. mark - marsh
14. slash - clad
15. gash - gap
16. rag - rash

Phase II B (Continued)

17. varnish - wave
18. gush - grave
19. brush - brave
20. have - thrash
21. lush - love
22. leave - leash
23. cough - Swedish
24. cherish - roof
25. hush - huff
26. calf - cash
27. half - hash
28. mush - muff
29. mustache - teeth
30. selfish - wreath
31. hearth - harsh
32. wrath - rush
33. bath - bash
34. mash - math
35. furnish - orange
36. mouthwash - rage
37. budge - bush
38. badge - bash
39. buzz - rosebush
40. roses - perish
41. fresh - freeze
42. **relish** - realize
43. as - ash
44. whizz - wish
45. fish - fizz
46. bush - hops
47. jacks - hush
48. publish - prince
49. caps - trash
50. punish - police
51. mash - miss
52. puss - push
53. mesh - mess
54. plush - plus
55. Swiss - swish
56. sash - witch
57. flush - reach
58. gosh - much
59. catch - crash
60. smash - match
61. ditch - dish
62. lash - latch
63. crush - crutch
64. witch - wish
65. leech - leash
66. hatch - hash
67. flash - ship
68. flesh - shut
69. sheep - blush
70. brush - shank
71. slash - shack
72. squash - shock

Phase II C

Now you have listened for words that have a /ʃ/ sound in the beginning and for words that have a /ʃ/ sound at the end. If a word has a /ʃ/ sound in it, but it is not at the beginning or at the end, we say that the /ʃ/ sound is in the middle of the word. No matter where the /ʃ/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: wishing has a /ʃ/ sound in the middle of it. Fishing has a /ʃ/ sound in the middle of it. Milkshake has a /ʃ/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /ʃ/ sound in the middle of it, the other will not. It is your job to decide which word has the /ʃ/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /ʃ/ sound in the middle. Remember, if word #1 has a /ʃ/ sound in the middle, push button #1. If word #2 has a /ʃ/ sound in the middle, push button #2.

Phase II C (Continued)

1. wishbone - fly
2. running - dishes
3. rushed - golden
4. happy - nutshell
5. flashlight - banana
6. raindrop - blushing
7. kangaroo - horseshoe
8. mushroom - coatroom
9. explore - exploration
10. multiply - multiplication
11. relax - relaxation
12. workshop - workbench
13. wishing - whipping
14. smashing - smacking
15. naked - nation
16. local - lotion
17. crashed - cracked
18. pushed - put
19. hat - hashed
20. education - educate
21. vacate - vacation
22. subtract - subtraction
23. action - actor
24. motion - motor
25. crushing - navy
26. waving - fraction
27. social - savage
28. gashing - gravel
29. over - ocean
30. musician - moving
31. session - seven
32. raven - ration
33. careful - election
34. mission - coughing
35. pushing - puffing
36. after - ashes
37. dictionary - dictaphone
38. before - seashore
39. relation - arithmetic
40. mansion - mother
41. anything - addition
42. faithful - fashion
43. notion - nothing
44. ashore - author
45. attraction - crazy
46. reason - creation
47. cheeseburger - bashful
48. cousin - cushion
49. lampshade - lambswool
50. washing - waltzing
51. patient - wasting
52. toasting - flashing
53. thunderstorm - thundershower
54. baseball - bushel
55. fishing - fasten
56. bashful - basket
57. sunshine - sunset
58. escaped - ashamed
59. tissue - miss you
60. passion - passing
61. witches - subtraction
62. crutches - trashcan
63. bushel - butcher
64. catcher - cashier
65. watching - washing
66. matches - mashes
67. toyshop - treasure
68. measure - machine

Phase Transition

Some of these words have one /ʃ/ sound in them, some of them have two /ʃ/ sounds in them. For instance, show has one /ʃ/ sound in it. Shipshape has two /ʃ/ sounds in it. You are to listen carefully and decide how many /ʃ/ sounds there are in a word. If there is one /ʃ/ sound, push button #1. If there are two /ʃ/ sounds, push button #2. Remember if you hear one /ʃ/ sound, push button number 1; if you hear two /ʃ/ sounds, push button number 2.

1. she
2. shush
3. milkshake
4. ash
5. crash
6. crashing
7. motion
8. emotion
9. sheepish

Phase Transition (Continued)

10. sheepishly
11. wished
12. wishing
13. wishy washy
14. mushrooms
15. shrimp
16. shaver
17. electric shaver
18. shipshape
19. shish kebab
20. sheriff
21. bashful
22. fashionshow
23. fish
24. fishes
25. shellfish
26. selfish
27. fresh fish
28. brush
29. toothbrush
30. thundershower
31. washcloth
32. shrewish
33. shrew
34. she's
35. dish
36. dishes
37. shilly-shally
38. musician
39. muscians
40. shoeshop
41. shoe
42. shoes
43. shoeshine
44. snowshoe
45. shoebrush
46. shell
47. seashell
48. seashells
49. seashore
50. shellshock
51. shoot
52. shooters
53. sharpshooters
54. sharpshooting
55. shot
56. snapshot
57. snapshots
58. shorts
59. shortish
60. sheet
61. sheets
62. shortsheets
63. station
64. stationary
65. washes
66. washstand
67. washing machine
68. washing

Phase III

Now it is your turn to decide where the /ʃ/ sound is. You will hear some words. Every word has a /ʃ/ sound in it. You are to decide if the /ʃ/ sound is in the beginning, the middle or the end of the word. If the word begins with /ʃ/ like shine, push the beginning button. If the word ends with /ʃ/ like dish, you push the end button. If the word has a /ʃ/ sound somewhere between the beginning and the end of the word like bashful, push the middle button. Remember push the beginning button if the word begins with /ʃ/, push the middle button if the word has the /ʃ/ sound in the middle and push the end button if the /ʃ/ sound is at the end.

1. shut
2. washday
3. dish
4. sheep
5. nutshell
6. punish
7. sharp
8. sheet
9. brush
10. cash
11. flashlight
12. marshmallow
13. pushcart
14. shampoo
15. milkshake
16. leash
17. shot
18. shotgun
19. goldfish
20. wishbone
21. cushion
22. shell
23. flash
24. flashing
25. wishing
26. wish
27. shore
28. ashore
29. dash
30. dashed
31. bushes
32. bush
33. shamed
34. ashamed
35. rush
36. rushed
37. emotion
38. motion
39. crash
40. crashed
41. ash
42. special

Phase III (Continued)

43. especially
44. shovel
45. vacation
46. shave
47. varnish
48. invitation
49. fishes
50. goldfish
51. toothbrush
52. thundershowers
53. washcloth
54. mouthwash
55. shoes
56. rosebush
57. wishes
58. shepherds
59. bushes
60. musician
61. education
62. stash
63. shots
64. smash
65. sash
66. splash
67. splashing
68. slash
69. shoestore
70. slush
71. sunshine
72. shops
73. shuts
74. shirts
75. snowshovel
76. snowshoe
77. shortstop
78. seashore
79. seashell
80. ships
81. selfish
82. shapes
83. spaceship
84. stylish
85. shoestand
86. squash
87. session
88. section
89. social

Phase IV

Now I'm going to say some more words to you. All of these words have a /ʃ/ sound in them. I will say each word twice. One of the times I will use a good /ʃ/ sound and one of the times I will not. If I use a good /ʃ/ sound the first time, push the first button. If I use a good /ʃ/ sound the second time, push the second button.*

Omit (ʃ)

shoeshine
ship
horseshoe
dictionary
shrewd
foolish
shine
hairbrush
washrag
dish
shrimp
wishy-washy

Substitute (v)

shipshape
wash
sunshine
shrink
shoe
pushcart
selfish
marsh
shop
thundershower
shrug
fashion show

---

*On first word of each group distort both /ʃ/ sounds. On last word of each group distort just first /ʃ/.

Phase IV (Continued)

Substitute (f)

shellfish
foolish
sharp
radish
sherbert
shortstop
showoff
washer
mustache
police station
trash can
washing machine

Substitute θ

shush
shriek
she
polish
marshmallow
washcloth
shotgun
smash
shoelace
rosebush
fresh
sureshot

Substitute (z)

shoeshop
pushing
sure
splash
shrink
shook
clothesbrush
snowshoe
rush
shame
vacation
shoeshop

Substitute (s)

fresh fish
publish
cashier
sugar
trash
action
shovel
cushion
shrimp
paintbrush
subtraction
sharpshooter

Substitute (tʃ)

shellshock
pressure
shirt
squash
session
shoulder
shriek
refresh
shadow
rushed
punish
fashion show

Substitute (ʒ)

short sheet
ash
crashed
showing
flesh
Sharon
pushed
shack
snapshot
wish
shortstop
shellfish

Phase IV (Continued)

Distort (snort)

sure shot
bush
shell
addition
crush
sheriff
radish
foolish
horeshoe
sherbert
windshield
shoebrush

Distort (whistle)

shipshape
mushroom
shove
workshop
shore
flash
washed
polish
splash
shadow
ash can
washing machine

Distort (lateral)

wishy-washy
showing
ocean
leash
sugar
rosebush
marsh
woodshed
finish
shoulder
washcloth
sharpshooter

Distort (sl. dist-tongue retracted)

shellshock
dish
sheep
special
goldfish
sharp
bashful
punish
mustache
shabby
spaceship
shush

Z Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /z/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /z/ is the blue button sound so you would push the blue button when you hear it. All other other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /z/, push the red button when you hear any other sound.

1. z
2. z
3. f
4. ʃ
5. z
6. f
7. tʃ
8. z
9. z
10. θ
11. z
12. θ
13. z
14. v
15. z
16. z
17. v
18. dʒ
19. ʒ
20. z
21. ʒ
22. z
23. s
24. s
25. z
26. z
27. s
28. ð
29. s
30. z
31. ð
32. z
33. ð
34. z
35. lateral distortion
36. /ð - z/ distortion
37. z
38. z
39. /ð - z/ distortion
40. z

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /z/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /z/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 lamp, word #2 zoo -- you would push button #2 because zoo begins with the /z/ sound. If I said word #1 zipper, word #2 month, you would push button #1 because zipper begins with a /z/ sound. Don't worry about how to spell the words, just listen for the /z/ sound. Remember, push button #1 if word #1 begins with the /z/ sound. Push button #2 if word #2 begins with the /z/ sound. Listen for the beginning of the words.

1. bottle - zoo
2. zipper - warm
3. row - zone
4. zigzag - lunchbox
5. leader - zebra
6. telephone - zylophone
7. zing - going
8. eel - zeal
9. rest - zest
10. zero - hero
11. zephr - heifer
12. bag - zag
13. lip - zip
14. room - zoom

Phase II A (Continued)

15. zany - brainy
16. zylophone - funny
17. zither - feather
18. fast - zest
19. zeal - feel
20. phone - zone
21. few - zoo
22. fling - zing
23. zipper - flipper
24. zero - sugar
25. shall - zinc
26. zany - shiny
27. zoom - shoe
28. zeal - shield
29. shy - xylophone
30. ship - zip
31. zephyr - thumb
32. thistle - zigzag
33. zoo - threw
34. throne - zone
35. zinc - think
36. valentine - zero
37. vane - zany
38. zag - van
39. zeal - veal
40. vest - zest
41. zip - than
42. zing - the
43. zag - that
44. their - zephyr
45. zither - this
46. zoom - those
47. these - zebra
48. seem - zigzag
49. zany - same
50. zag - snag
51. slipper - zipper
52. zing - sting
53. sue - zoo
54. sink - zinc
55. seal - zeal
56. zip - sip
57. zebra - seabreeze

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /z/ sound at the end of it -- the other will not. It is your job to decide which word ends with /z/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /z/ sound at the end. Remember if word #1 ends with /z/, push button #1. If word #2 ends with /z/, push button #2. Listen to the end sound.

1. buzz - no
2. sight - size
3. rise - right
4. lose - loop
5. breed - breeze
6. pride - prize
7. confuse - construct
8. think - things
9. sneer - sneeze
10. use - you
11. tease - tea
12. those - although
13. ray - raise
14. cage - cages
15. tree - trees
16. ones - one
17. rose - row
18. hill - hills
19. stand - stands
20. rings - ring
21. dogs - dog
22. robe - robes
23. fish - fizz
24. whiz - witch
25. beach - bees
26. ease - each
27. please - deaf
28. grease - sniff
29. cough - because
30. if - is
31. lies - life
32. cheese - chief

Phase II B (Continued)

33. bridge - pose
34. blaze - cage
35. ridge - reads
36. ends - edge
37. cabbage - capsize
38. oars - orange
39. pays - page
40. huge - hues
41. lodge - laws
42. fudge - fuzz
43. ooze - love
44. amuse - above
45. stove - nose
46. have - as
47. does - dove
48. graze - grave
49. rose - rove
50. gave - gaze
51. heave - he's
52. arise - arrive
53. breeze - breath
54. sells - stealth
55. teeth - tease
56. bows - both
57. wells - wealth
58. grows - growth
59. faith - phase
60. girls - garage
61. mirage - dishes
62. boys - beige
63. ruse - rouge
64. loathe - rolls
65. days - bathe
66. writhe - these
67. wheeze - wreathe
68. snooze - smooth
69. lithe - lies
70. tease - teethe
71. breeze - breathe
72. close - clothe
73. grapes - has
74. as - ducks
75. please - police
76. plays - place
77. race - raise
78. buzz - bus
79. hiss - his
80. fox - fogs
81. rice - rise
82. ones - once
83. frocks - frogs
84. dogs - docks
85. seats - seeds
86. ropes - robes
87. pans - pants
88. east - ease
89. hasn't - has
90. confused - confuse
91. amuse - amusing
92. wise - wiser

Phase II C

Now you have listened for words that have a /z/ sound in the beginning and for words that have a /z/ sound at the end. If a word has a /z/ sound in it, but it is not at the beginning or at the end, we say that the /z/ sound is in the middle of the word. No matter where the /z/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: dozen has a /z/ sound in the middle of it. Music has a /z/ sound in the middle of it. Buzy has a /z/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /z/ sound in the middle of it, the other will not. It is your job to decide which word has the /z/ sound in the middle. If it is word #1, push button #1. If it is word #2 push button #2. Don't worry about how to spell the words, just listen for the /z/ sound in the middle. Remember, if word #1 has a /z/ sound in the middle, push

Phase II C (Continued)

button #1. If word #2 has a /z/ sound in the middle, push button #2.

1. fuzzy - rider
2. goodbye - music
3. blazer - raindrop
4. cupcake - cousin
5. lazy - lady
6. report - resort
7. matchbox - puzzle
8. weasel - teacher
9. afraid - amusing
10. isn't - itchy
11. dutchman - dozen
12. hatching - hazard
13. reaching - reason
14. cozy - coaching
15. raspberry - laughter
16. refuel - resume
17. dizzy - different
18. define - design
19. referee - resident
20. deserve - defend
21. Hazel - hateful
22. buzzing - buffing
23. imagine - nosedive
24. organization - legend
25. busy - bridges
26. husband - hedges
27. major - amazing
28. prison - pigeon
29. raisin - raging
30. region - season
31. addition - Arizona
32. fertilizer - sugar
33. bashful - cheeseburger
34. lampshade - lambswool
35. crazy - cracking
36. dozing - ocean
37. fishing - pleasant
38. cushion - cousin
39. wishing - wizard
40. New Jersey - valentine
41. busy - beaver
42. heaven - hesitate
43. reveal - newsreel
44. desert - develop
45. liver - lizard
46. present - prevent
47. haven't - hasn't
48. easel - evil
49. newspaper - theater
50. earthquake - chisel
51. freezer - ether
52. southward - trousers
53. Thursday - birthday
54. arithmetic - arisen
55. bother - posy
56. another - magazine
57. lazy - leather
58. without - wizard
59. clothing - dozing
60. muzzle - mother
61. feather - pheasant
62. enter - teaser
63. noisy - measure
64. president - visual
65. explosion - rosy
66. visor - vision
67. division - dissolve
68. frozen - erosion
69. confusion - confusing
70. usable - usual
71. wizard - whisper
72. crazy - crisscross
73. dozen - dustpan
74. itself - daisy
75. rooster - desert
76. mistake - music
77. cousin - custard
78. Wednesday - western
79. thirsty - Thursday
80. racer - razor
81. dizzy - distant
82. lacey - lazy
83. east - easy
84. fuzzy - fussy

Phase Transition

Some of these words have one /z/ sound in them, some of them have two /z/ sounds in them. For instance, zeal has one /z/ sound in it. Measles has two /z/ sounds in it. You are to listen carefully and decide how many /z/ sounds there are in a word. If there is one /z/ sound, push button #1. If there are two /z/ sounds, push button #2. Remember if you hear one /z/ sound, push button number 1; if you hear two /z/ sounds, push button number 2.

1. zag
2. zigzag
3. zebra
4. zebras
5. tweezers
6. tweezer
7. fuzzy
8. fuzziest
9. fuzzywuzzy
10. daisy
11. daisies
12. nose
13. nosy
14. posy
15. posies
16. rosebush
17. rosebushes
18. bushes
19. brushes
20. civilization
21. civilizations
22. cheeses
23. cheese
24. churches
25. bathtubs
26. toothbrushes
27. zippers
28. raspberries
29. breathes
30. those
31. these
32. disease
33. deserve
34. deserves
35. deserved
36. music
37. musicbox
38. musician
39. seasons
40. seasoning
41. seasoned
42. reason
43. reasons
44. reasoning
45. exercise
46. exercised
47. praises
48. praising
49. praised
50. size
51. sizes
52. poisons
53. poisoning
54. poisoned
55. use
56. uses
57. sunflowers
58. Suzy
59. closets
60. oozes
61. oozed
62. snoozing
63. scissor
64. scissors
65. closets
66. closet
67. desert
68. deserts
69. teases
70. tease
71. raisin
72. raisins
73. saws
74. seesaws
75. soapsuds

Phase III

Now it is your turn to decide where the /z/ sound is. You will hear some words. Every word has a /z/ sound in it. You are to decide if the /z/ sound is in the beginning, the middle or the end of the word. If the word begins with /z/ like zoo, push the beginning button. If the word ends with /z/ like nose, you push the end button. If the word has a /z/ sound somewhere between the beginning and the end of the word like lazy push the middle button. Remember push the beginning button if the word begins with /z/, push the middle button if the word has the /z/ sound in the middle and push the end button if the /z/ sound is at the end.

Phase III (Continued)

1. zoo
2. cozy
3. jazz
4. zone
5. dizzy
6. is
7. dessert
8. hazard
9. has
10. zero
11. cheese
12. cheeseburger
13. amaze
14. amazing
15. zebra
16. easy
17. ease
18. easily
19. lazy
20. zing
21. wizard
22. zeal
23. zipper
24. does
25. fuzzy
26. fuzz
27. lizard
28. cause
29. because
30. zag
31. weasel
32. wasn't
33. was
34. graze
35. crazy
36. amusing
37. amuse
38. zephyr
39. flies
40. freezing
41. xylophone
42. nose
43. shoes
44. rosebush
45. zoom
46. ooze
47. shoves
48. organization
49. shaves
50. visor
51. movies
52. positive
53. vase
54. zest
55. size
56. surprise
57. zip
58. zips
59. sees
60. season
61. Suzy
62. presents
63. snows
64. squeeze
65. Thursday
66. zither
67. thumbs
68. thaws
69. thousand
70. zenith
71. sizzle
72. otherwise
73. those
74. these
75. soothes

Phase IV

Now I'm going to say some more words to you. All of these words have a /z/ sound in them. I will say each word twice. One of the times I will use a good /z/ sound and one of the times I will not. If I use a good /z/ sound the first time, push the first button. If I use a good /z/ sound the second time, push the second button.*

Omit (z)	Substitute (d)
raisins	poisons
deserve	isn't
is	monkeys
easel	desert
zoo	please
gauze	refuse
dozen	zing
surprise	husband

---

*On first word of each group distort both /z/ sounds. On last word of each group distort just first /z/.

Phase IV (Continued)

pleasant
these
amuse
disease
has
music
breeze
cousins

Substitute (g)

raspberries
rose
wasn't
organize
lazy
girls
zero
amazement
chosen
noise
fizz
deserves

Substitute (dʒ)

surprises
news
lizard
buzzing
freeze
zone
was
lies
hasn't
easy
saws
noises

Substitute (v)

sizes
lazy
prunes
closet
these
raspberry
pheasant
sneeze
zebra
choose
daisy
teases

Substitute (s)

praises
oysters
crazy
zinc
does
spoons
lizard
commands
dizzy
wise
weasel
oozes

Substitute (ð)

dozens
fans
claws
amusement
zither
ooze
those
hazy
trays
rising
squeeze
hazards

Distort snort

fuzzywuzzy
prize
grease
doze
razor
zeal
miser
confusing
buzzard
horses
paws
reasons

Phase IV (Continued)

Distort - lateral

scissors
toes
physician
froze
resist
xylophone
buys
hazard
clowns
posy
graze
measles

Distort - slight lateral

lizards
because
woods
chimpanzee
dazzle
tables
result
bears
horizon
zoo
hypnotize
zigzag

Distort - whistle

snoozes
crabs
zipper
bees
fertilizer
presume
shoestrings
miserable
grizzly
exercise
eggs
trousers

Distort - slight whistle

uses
skies
freezing
pasteurize
hesitate
panthers
Tuesday
dissolve
cars
zoom
musicbox
tweezers

/θ/ Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /θ/ sound, push the blue button; when you hear any other sound, push the red button. For instance: /θ/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /θ/, push the red button when you hear any other sound.

1. θ
2. θ
3. s
4. v
5. θ
6. v
7. θ
8. θ
9. z
10. θ
11. ʃ
12. θ
13. ʃ
14. z
15. θ
16. f
17. θ
18. t
19. θ
20. θ
21. s
22. θ
23. t
24. θ
25. s
26. t
27. θ
28. ð
29. t
30. ð
31. θ
32. θ
33. ð
34. θ
35. θ distort
36. θ
37. θ distort
38. ð
39. θ
40. θ distort

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /θ/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /θ/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 think, word #2 boy -- you would push button #1 because think begins with the /θ/ sound. If I said word #1 cat, word #2 thumb, you would push button #2 because thumb begins with a /θ/ sound. Don't worry about how to spell the words, just listen for the /θ/ sound. Remember, push button #1 if word #1 begins with the /θ/ sound. Push button #2 if word #2 begins with the /θ/ sound. Listen for the beginning of the words.

1. thermometer - going
2. walk - thanksgiving
3. thousand - king
4. love - thunderbird
5. thumbtack - hunchback
6. whistle - thistle
7. threshhold - behold
8. thinking - inking
9. ought - thought
10. rust - thrust
11. rash - thrash
12. theory - eerie
13. thumb - gum
14. dirty - thirty

Phase II A (Continued)

15. wick - thick
16. thank - yank
17. thud - mud
18. lift - thrift
19. throb - rob
20. nimble - thimble
21. thaw - paw
22. thin - pin
23. thirst - burst
24. jump - thump
25. thicken - chicken
26. thriller - chiller
27. thirst - table
28. tub - thumb
29. throb - trot
30. tankful - thankful
31. thought - taught
32. thorn - torn
33. tick - thick
34. vine - thankful
35. theater - veal
36. theft - vest
37. thatch - vat
38. vie - thigh
39. thought - vault
40. vote - throat
41. thousand - zero
42. thorn - zipper
43. throw - zone
44. zoo - thorough
45. think - zinc
46. thing - zing
47. shopping - throttle
48. third - sherbert
49. thud - shut
50. shorn - thorn
51. shin - thin
52. thunder - salt
53. thug - spray
54. thoroughly - soup
55. splash - thanks
56. thickness - sickness
57. some - thumb
58. spread - thread
59. throne - stone
60. from - Thursday
61. freak - Thelma
62. friend - thread
63. finger - thinker
64. thresher - fresher
65. thin - fin
66. free - three
67. thirst - first
68. fought - thought
69. threat - fret
70. thimble - the
71. then - thermos
72. they - thicken
73. thirst - there
74. thief - these
75. theme - thee
76. this - thin
77. thus - thud
78. that - thatch
79. thousand - thou
80. thigh - thy

Part II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /θ/ sound at the end of it -- the other will not. It is your job to decide which word ends with /θ/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /θ/ sound at the end. Remember if word #1 ends with /θ/, push button #1. If word #2 ends with /θ/, push button #2. Listen to the end sound.

1. birdbath - clean
2. blue - mirth
3. Elizabeth - pet
4. afternoon- aftermath
5. save - south
6. five - fifth

Phase II B (Continued)

7. path - pave
8. live - length
9. relieve - underneath
10. earth - errors
11. filth - fills
12. warmth - warms
13. hers - hearth
14. wells - wealth
15. grows - growth
16. bath - bash
17. hath - hash
18. mash - math
19. rash - wrath
20. boot - booth
21. death - debt
22. Beth - bet
23. root - truth
24. tooth - toot
25. fate - faith
26. strength - rent
27. mutt - month
28. north - necks
29. breath - blouse
30. eats - Edith
31. cross - cloth
32. goose - both
33. health - else
34. both - boats
35. loose - sleuth
36. moss - moth
37. fourth - force
38. youth - use
39. truth - tough
40. shelf - health
41. oath - oaf
42. roof - Ruth
43. depth - deaf
44. reef - wreath
45. miff - myth
46. beneath - belief
47. bathe - bath
48. breath - breathe
49. loathe - loath
50. mouth - mouthe
51. sheath - sheathe
52. teeth - teethe
53. think - tablecloth
54. Kenneth - thief
55. thermos - birth
56. worth - third

Phase II C

Now you have listened for words that have a /θ/ sound in the beginning and for words that have a /θ/ sound at the end. If a word has a /θ/ sound in it, but it is not at the beginning or at the end, we say that the /θ/ sound is in the middle of the word. No matter where the /θ/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: bathtub has a /θ/ sound in the middle of it. Toothpaste has a /θ/ sound in the middle of it. Pathway has a /θ/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /θ/ sound in the middle of it, the other will not. It is your job to decide which word has the /θ/ sound in the middle. If it is word #1, push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /θ/ sound in the middle. Remember, if word #1 has a /θ/ sound in the middle, push button #1. If word #2 has a /θ/ sound in the middle, push button #2.

1. birthday - tire
2. lollipop - mathematics
3. authority - city
4. clock - Bartholomew
5. Kathleen - cannon
6. pattern - toothpaste

Phase II C (Continued)

7. full - truthful
8. mouthwash - wash
9. bathhouse - birdhouse
10. forward - northward
11. usual - youthful
12. haven - Nathan
13. strengthen - seven
14. everything - even
15. pavement - pathway
16. faithful - favor
17. Irving - earthling
18. newspaper - bathroom
19. toothpicks - trousers
20. cathedral - cousin
21. arithmetic - arisen
22. freezer - ether
23. facial - ethical
24. breakthrough - bashful
25. Catholic - cashing
26. anything - addition
27. mushy - monthly
28. Martha - Marsha
29. everything - blessing
30. basket - bathtub
31. arithmetic - accident
32. nicely - nothing
33. saucer - something
34. master - Matthew
35. panther - answer
36. Catherine - aspirin
37. mousy - mouthy
38. moustache - mothball
39. darting - Dorothy
40. mouthpiece - mountain
41. playthings - playtime
42. antler - anthem
43. oats - oaths
44. booths - boots
45. firefly - wealthy
46. Ruthie - rooftop
47. afternoon - athletic
48. author - offer
49. athlete - affect
50. symphony - sympathy
51. Ethel - effort
52. deafly - deathly
53. unhealthy - other
54. rather - toothache
55. mouthful - mother
56. toothpaste - together
57. feather - faithful
58. lengthen - leather
59. smother - something
60. southwest - southern
61. heathen - healthy
62. wealthy - weather
63. unworthy - worthwhile
64. brother - Bertha
65. ether - either

Phase III

Now it is your turn to decide where the /θ/ sound is. You will hear some words. Every word has a /θ/ sound in it. You are to decide if the /θ/ sound is in the beginning, the middle or the end of the word. If the word begins with /θ/ like thin, push the beginning button. If the word ends with /θ/ like both, you push the end button. If the word has a /θ/ sound somewhere between the beginning and the end of the word like birthday push the middle button. Remember push the beginning button if the word begins with /θ/, push the middle button if the word has the /θ/ sound in the middle and push the end button if the /θ/ sound is at the end.

1. thrill
2. bathroom
3. oath
4. thick
5. Nathan
6. death
7. thud
8. thaw
9. beneath

Phase III (Continued)

10. warmth
11. cathedral
12. Arthur
13. mothball
14. panther
15. path
16. thermos
17. thermos bottle
18. Kenneth
19. Martha
20. Theodore
21. health
22. healthy
23. healthiest
24. earth
25. something
26. thing
27. anything
28. south
29. southwest
30. birth
31. birthday
32. third
33. thirty
34. one-thirty
35. thirty-one
36. bath
37. bathroom
38. bathhouse
39. mathematics
40. math
41. think
42. thank
43. rethink
44. thankless
45. wealth
46. wealthy
47. lengthen
48. lengthening
49. length
50. thin
51. eleventh
52. thieves
53. everything
54. Thursday
55. Elizabeth
56. thousand
57. thumbs
58. dishcloth
60. thrash
70. thrashing
71. thresher
72. sheath
73. toothbrush
74. theft
75. thief
76. faith
77. faithful
78. thrift
79. thrifty
80. mouthful
81. thoughtful
82. thought
83. fifth
84. truthful
85. truth
86. tooth
87. toothpaste
88. arithmetic
89. thermometer
90. athletic
91. thirteen
92. thirst
93. southeast
94. strength
95. strengthening
96. thermostat
97. thanksgiving
98. sympathy
99. mouthpiece

Phase IV

Now I'm going to say some more words to you. All of these words have a /θ/ sound in them. I will say each word twice. One of the times I will use a good /θ/ sound and one of the times I will not. If I use a good /θ/ sound the first time, push the first button. If I sue a good /θ/ sound the second time, push the second button.

Omit	Substitute /v/
thermos	thrill
sympathy	author
birth	Edith
thoughtful	thankless
depth	within
mouthful	booth
three	thick
mammoth	something
wealthy	thirty
through	worth

Phase IV (Continued)

month
thaw

Substitute /z/

ether
theater
strengthen
throne
nothing
thermostat
myth
death
thin
Elizabeth
throat
athlete

Substitute /f/

toothpaste
throb
beneath
mothball
Thursday
tooth
North Dakota
growth
thrown
month
thumb
worthwhile

Substitute /s/

theft
earthquake
both
Kenneth
thermometer
health
athlete
dishcloth
third
birthday
truthful
thorn

throb
birdbath

Substitute /ʃ/

anything
teeth
think
Bertha
southeast
mouth
thicken
arithmetic
thresher
bath
strengthen
thatch

Substitute /t/

underneath
everything
truth
Theodore
toothache
throw
north
thanksgiving
bathhouse
Thelma
panther
warmth

Substitute /ð/

eighth
thing
toothpick
thousand
death
moth
thief
lengthen
tablecloth
cathedral
thirst
Matthew

Phase IV (Continued)

Distort - tongue to side

unhealthy
youth
thankful
fourth
North America
Theodore
fifth
cloth
thickening
thud
youthful
strength

Distort - snort

Martha
south
theatrical
earth
bathtub
thigh
athletic
worth
thoughtless
hath
thrift
healthy

Distort - "wet"

thundering
wreath
Kathleen
thumbs
eighteenth
bathroom
thug
lengthen
mouthpiece
oath
math
thirty-three

Distort - tongue behind teeth

Dorothy
thrush
wealth
method
thriller
without
breath
thermos bottle
faith
northeast
wrath
thirteenth

/ð /Program

Phase I

You are going to hear a lot of sounds, one at a time. When you hear a /ð / sound, push the blue button; when you hear any other sound, push the red button. For instance: /ð/ is the blue button sound so you would push the blue button when you hear it. All other sounds are red button sounds so you would push the red button when you hear them. Remember push the blue button when you hear /ð /, push the red button when you hear any other sound.

1. ð
2. ð
3. dʒ
4. ð
5. ʒ
6. ð
7. ð
8. ʃ
9. ð
10. z
11. ð
12. f
13. ð
14. ð
15. z
16. f
17. d
18. ð
19. θ
20. ð
21. v
22. z
23. ð
24. d
25. θ
26. v
27. ð (distort)
28. ð (distort)
29. θ
30. ð

Phase II A

I am now going to say some pairs of words. In every pair one of the words will have a /ð/ sound at the beginning of it and the other word will not. It is your job to decide which word begins with the /ð/ sound. If it is the first word push button #1. If it is the second word push button #2. For example, if I say word #1 this, word #2 boy -- you would push button #1 because this begins with the /ð / sound. If I said word #1 house, word #2 them, you would push button #2 because them begins with a /ð/ sound. Don't worry about how to spell the words, just listen for the /ð/ sound. Remember, push button #1 if word #1 begins with the /ð / sound. Push button #2 if word #2 begins with the /ð / sound. Listen for the beginning of the words.

1. them - boy
2. doll - thereafter
3. they - afraid
4. quarter - thenceforth
5. therein - wherein
6. thyself - myself
7. tease - these
8. thou - towel
9. thine - tine
10. favor - therefore
11. fine - thine
12. those - foes
13. fuss - thus
14. fence - thence
15. the - shovel
16. sheriff - thereby
17. this - shift
18. thou - shall
19. shade - they'd
20. zip - than

Phase II A (Continued)

21. zing - the
22. that - zag
23. theirs - zephyrs
24. zither - this
25. those - zoom
26. zebra - these
27. themselves - value
28. than - van
29. vale - they'll
30. thine - vine
31. that - not
32. V - thee
33. thereat - diamond
34. dense - thence
35. though - dough
36. they've - Dave
37. den - then
38. thy - die
39. day - they
40. dare - there
41. they - thicken
42. thermos - then
43. thirst - there
44. these - thief
45. theme - thee
46. this - thin
47. thud - thus
48. thatch - that
49. than - thousand
50. thigh - thy

Phase II B

Now I'm going to say some pairs of words. In these pairs one of these words will have a /ð/ sound at the end of it -- the other will not. It is your job to decide which word ends with /ð/. If it is word #1 push button #1. If it is word #2, push button #2. Don't worry about how to spell the words, just listen for the /ð/ sound at the end. Remember if word #1 ends with /ð/, push button #1. If word #2 ends with /ð/, push button #2. Listen to the end sound.

1. mouthe - frog
2. trouble - bathe
3. smooth - airplane
4. soup - soothe
5. cloak - clothe
6. teach - teethe
7. seethe - seat
8. dish - mouthe
9. swish - swathe
10. bathe - bash
11. with - wish
12. betroth - bread
13. toad - clothe
14. lad - lathe
15. soothe - sued
16. lathe - laid
17. seed - seethe
18. tide - tithe
19. writhe - weave
20. smooth - move
21. sleeve - sheathe
22. clove - clothe
23. loathe - rolls
24. days - bathe
25. scythe - size
26. wreathe - wheeze
27. smoothe - snooze
28. lies - lithe
29. tease - teethe
30. clothe - close
31. unclothe - month
32. path - tithe
33. betroth - both
34. bath - bathe
35. breathe - breath
36. loath - loathe
37. mouthe - mouth
38. sheathe - sheath
39. teeth - teethe

Phase II C

Now you have listened for words that have a /ð/ sound in the beginning and for words that have a /ð/ sound at the end. If a word has a /ð/ sound in it, but it is not at the beginning or at the end, we say that the /ð/ sound is in the middle of the word. No matter where the /ð/ sound is in the word as long as it is not at the beginning and not at the end, we say it is in the middle. For example: bother has a /ð/ sound in the middle of it. Another has a /ð/ sound in the middle of it. Rather has a /ð/ sound in the middle. This time you are to listen for some other pairs of words. In these pairs one of the words will have a /ð/ sound in the middle of it, the other will not. It is your job to decide which word has the /ð/ sound in the middle. If it is word #1, push button #1. If it is word #2 push button #2. Don't worry about how to spell the words, just listen for the /ð/ sound in the middle. Remember, if word #1 has a /ð/ sound in the middle, push button #1. If word #2 has a /ð/ sound in the middle, push button #2.

1. brother - cereal
2. whisper - feather
3. smother - raccoon
4. alright - altogether
5. grandmother - grandstand
6. neighborhood - Netherlands
7. nursing - northern
8. weatherman - western
9. gather - alligator
10. wetter - weather
11. hitter - hither
12. fever - further
13. breathing - briefing
14. others - ushers
15. graded - gather
16. obeyed - bathed
17. father - fodder
18. breeding - breathing
19. load - loathed
20. worthy - wordy
21. further - proving
22. dither - divide
23. weaver - wither
24. never - neither
25. rather - river
26. fathom - favor
27. farthest - harvest
28. loaves - loathes
29. bother - posy
30. another - magazine
31. lazy - leather
32. without - wizard
33. dozing - clothing
34. muzzle - mother
35. pheasant - feather
36. smoothly - youthful
37. toothpaste - together
38. faithful - farthing
39. something - smother
40. southwest - southern
41. heathen - healthy
42. another - other
43. wealthy - weather
44. unworthy - worthwhile
45. brother - Bertha
46. ether - either

Phase III

Now it is your turn to decide where the /ð/ sound is. You will hear some words. Every word has a /ð/ sound in it. You are to decide if the /ð/ sound is in the beginning, the middle or the end of the word. If the word begins with /ð/ like there, push the beginning button. If the word ends with

Phase III (Continued)

/ð/ like bathe, you push the end button. If the word has a /ð/ sound somewhere between the beginning and the end of the word like mother push the middle button. Remember push the beginning button if the word begins with /ð/, push the middle button if the word has the /ð/ sound in the middle and push the end button if the /ð/ sound is at the end.

1. than
2. father
3. bathe
4. thyself
5. southern
6. writhe
7. these
8. weather-beaten
9. swathe
10. mother
11. another
12. that
13. that's
14. loathe
15. loathesome
16. loathed
17. breathing
18. breathed
19. breathe
20. clothing
21. clothed
22. clothe
23. though
24. although
25. bother
26. brother
27. there
28. smooth
29. smoother
30. smother
31. other
32. others
33. thereby
34. these
35. seethes
36. seethe
37. scathe
38. scathed
39. unscathed
40. with
41. without
42. withered
43. teethe
44. teethed
45. these
46. teething
47. themselves
48. them
49. dither
50. either

Phase IV

Now I'm going to say some more words to you. All of these words have a /ð/ sound in them. I will say each word twice. One of the times I will use a good /ð/ sound and one of the times I will not. If I use a good /ð/ sound the first time, push the first button. If I use a good /ð/ sound the second time, push the second button.

Omit /ð/	Substitute /ʃ/
thee	Netherlands
altogether	writhe
bathe	fathom
bother	that
unworthy	this
northerner	further
scathe	breathe
loathful	weather
them	grandfather
mouthing	scythe
swarthy	neither
thence	thus

Phase IV (Continued)

Substitute /z/

the
other
mouthe
thy
smooth
wither
these
smoothly
bathe
within
gather
another

Substitute /v/

teethe
withdrawn
theirs
breathing
seethe
brother
either
sheathe
unsheathed
though
northern
thenceforth

Distort (snort)

soothe
father
further
clothe
leather
seaworthy
then
stepmother
lithe
weatherman
those
they've

Substitute /ð/

unclothe
smother
than
heathen
betroth
rather
thyself
worthy
with
they
openmouthed
with

Substitute /θ/

thine
breathed
clothe
therefore
southern
lathe
hither
there
although
swathe
gathered
heather

Distort (wet)

that
wreathe
feather
fathom
themselves
hitherto
loathe
wither
mother
breathe
together
thereat

APPENDIX B

Specific Discrimination Tests

S Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. ʃ - s
2. s - z
3. s - ʃ
4. s - s
5. ʒ - s
6. θ - s
7. s - s
8. s - θ
9. s - s
10. s - f

B. I am now going to read you a list of words. If the word has a /s/ in it write YES on your paper. If it doesn't have a /s/ in it write NO on your paper.

1. zoo
2. sheet
3. bicycle
4. north
5. skate
6. ocean
7. smile
8. music
9. thumb
10. basket
11. treasure
12. fuzzy
13. nest
14. wash
15. center
16. lips

C. How many /s/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. beanstalks
2. Suzy
3. sewing circle
4. soapsuds
5. snowshovel
6. skirts
7. thinks
8. recess
9. sunflowers
10. princess

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. dress
2. stranger /ʃ/
3. soldier /ʒ/
4. soup
5. goose /f/
6. pencil
7. once /f/
8. screen
9. spring
10. tricycle /k/
11. baseball /z/
12. this /ð/
13. tax
14. escape (lateral)
15. sad
16. exclaim (lateral)
17. swell (whistle
18. windowsill (frontal lisp)

R Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. dʒ - r
2. r - j
3. r - dʒ
4. r - r
5. tʃ - r
6. f - r
7. r - r
8. r - f
9. r - r
10. w - r

B. I am now going to read you a list of words. If the word has an /r/ in it write YES on your paper. If it doesn't have an /r/ in it write NO on your paper.

1. wound
2. jar
3. berry
4. sunny
5. north
6. yellow
7. rock
8. cheat
9. hush
10. narrow
11. handle
12. white
13. cage
14. fine
15. parade
16. air

C. How many /r/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. railroad
2. wire
3. gingerbread
4. mirror
5. wristwatch
6. winner
7. cherry
8. hamburger
9. part
10. orchard

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. store
2. bridge (omit)
3. wrinkle /m/
4. around
5. raindrop /g/
6. running
7. rubber /l/
8. chair
9. pepper
10. robin /j/
11. bring /w/
12. terrible /w/
13. razor
14. kangaroo /w/
15. arrow
16. horse /dr/
17. girl (trill)
18. giraffe (dist)

F Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. f - l
2. b - f
3. ð - f
4. f - f
5. f - p
6. s - f
7. f - f
8. f - s
9. v - f
10. f - v

B. I am now going to read you a list of words. If the word has a /f/ in it write YES on your paper. If it doesn't have a /f/ in it write NO on your paper.

1. that
2. point
3. phone
4. sporty
5. shelf
6. vine
7. thrift
8. mattress
9. pound
10. enough
11. van
12. this
13. paragraph
14. wish
15. life
16. feather

C. How many /f/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. fluffy
2. coughdrop
3. fifth
4. phonograph
5. perfume
6. feather
7. skuffle
8. faithful
9. lifesaver
10. alfalfa

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. football
2. leaf /b/
3. laughter /s/
4. after
5. phone /ʒ/
6. giraffe
7. suffer /ð/
8. fine
9. grief
10. raffle /ʒ/
11. life /ʃ/
12. forest /θ/
13. taffy
14. lift (dist)
15. flame
16. fever /v/
17. failure (dist)
18. laughing /θ/

L Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. m - l
2. l - u
3. r - l
4. l - l
5. j - l
6. l - au
7. l - l
8. l - w
9. w - l
10. l - l dist

B. I am now going to read you a list of words. If the word has an /l/ in it write YES on your paper. If it doesn't have an /l/ in it write NO on your paper.

1. moose
2. week
3. learn
4. poor
5. tale
6. father
7. pilot
8. rather
9. severe
10. million
11. yes
12. how
13. false
14. tire
15. lark
16. eagle

C. How many /l/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. likely
2. walrus
3. lonely
4. wholesale
5. flash
6. wolf
7. relax
8. lollipop
9. walnut
10. hillbilly

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully?

1. lady
2. alligator /m/
3. lion /j/
4. asleep
5. telephone /r/
6. hospital
7. palace /au/
8. lighthouse
9. whale
10. saddle /w/
11. lettuce /w/
12. sunflower (omit)
13. swallow
14. pupil (dist)
15. eleven
16. lizard (dist)
17. elephant /w/
18. silver (dist)

K Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. k - h
2. tʃ - k
3. k - d
4. k - k
5. p - k
6. k - ŋ
7. k - k
8. t - k
9. k - k
10. g - k

B. I am now going to read you a list of words. If the word has a /k/ in it write YES on your paper. If it doesn't have a /k/ in it write NO on your paper.

1. hamburger
2. stitch
3. clue
4. tomahawk
5. crumble
6. wringer
7. October
8. eggshell
9. great
10. escape
11. frosty
12. begin
13. wick
14. pollywog
15. crate
16. excellent

C. How many /k/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. scarecrow
2. chipmunk
3. crocodile
4. microscope
5. congratulate
6. kindergarten
7. cucumber
8. catcher
9. handkerchief
10. boxing gloves

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. pussycat
2. thanksgiving /tʃ/
3. canvas /d/
4. excellent
5. escape /p/
6. tricycle
7. link /ŋ/
8. cable
9. accident /t/
10. beanstalk
11. cardboard
12. twinkle /g/
13. accept
14. cream /g/
15. magic
16. circus (cough)
17. cannon /kl/
18. snake (dist)

G Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. p - g
2. g - g
3. g - m
4. d - g
5. g - t
6. g - g
7. g - ɣ
8. n - g
9. g - ŋ
10. g - k

B. I am now going to read you a list of words. If the word has a /g/ in it write YES on your paper. If it doesn't have a /g/ in it write NO on your paper.

1. rank
2. tongue
3. anchor
4. begin
5. open
6. reject
7. laugh
8. cigar
9. juice
10. enjoy
11. pigeon
12. dragon
13. escape
14. snug
15. engine
16. badge

C. How many /g/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. struggle
2. gag
3. garage
4. eggnog
5. gadget
6. gargle
7. piggy
8. magazine
9. congregate
10. organ-grinder

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. seagull
2. underdog /d/
3. drug store /t/
4. rogue
5. groom
6. pigtail /tʃ/
7. gigantic /d /
8. hamburger /k/
9. league
10. pegleg
11. iceberg /ŋ/
12. growl
13. tugboat /ɣ/
14. gallon
15. goggles /k/
16. golden
17. begin /dʒ/
18. monologue

/ʃ/ Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. ʃ - v
2. f - ʃ
3. ʃ - z
4. ʃ - ʃ
5. θ - ʃ
6. ʃ - ʒ
7. ʃ - ʃ
8. s - ʃ
9. ʃ - ʃ
10. tʃ - ʃ

B. I am now going to read you a list of words. If the word has a /ʃ/ in it write YES on your paper. If it doesn't have a /ʃ/ in it write NO on your paper.

1. vowel
2. thief
3. addition
4. machine
5. sugar
6. matches
7. shoulder
8. sunset
9. judge
10. tissue
11. treasure
12. baseball
13. musician
14. waltzing
15. shoelace
16. radish

C. How many /ʃ/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. shoeshop
2. washstand
3. shellfish
4. shush
5. stationary
6. toothbrush
7. sheriff
8. sureshot
9. milkshake
10. washing machine

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. dictionary
2. pushcart /v/
3. mustache /f/
4. marshmallow
5. washcloth /θ/
6. shreik
7. snowshoe /z/
8. splash
9. sugar /s/
10. session /tʃ/
11. ash /ʒ/
12. refresh
13. sure
14. sherbert (snort)
15. special
16. showing (lateral)
17. workshop (whistle)
18. goldfish (retracted tongue)

Z Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. z - dʒ
2. ð - z
3. z - z
4. ʒ - z
5. ð - z
6. z - z
7. z - ʒ
8. s - z
9. z - s
10. z - z

B. I am now going to read you a list of words. If the word has a /z/ in it write YES on your paper. If it doesn't have a /z/ in it write NO on your paper.

1. sip
2. beige
3. zoo
4. rice
5. these
6. seal
7. lizard
8. going
9. vest
10. zip
11. distant
12. mother
13. busy
14. this
15. snooze
16. raisin

C. How many /z/ sounds are in these words? If there is 1 write 1 in the blank. If there are 2 write 2 in the blank. Listen carefully:

1. blizzard
2. measles
3. music
4. deserve
5. zigzag
6. roses
7. size
8. sneezing
9. scissors
10. sizzle

D. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully:

1. raisins (omit)
2. because
3. wizard
4. poison /d/
5. raspberries /g/
6. his
7. surprise /dʒ/
8. zoom /ð/
9. dizzy
10. zebra /v/
11. bees
12. praise /s/
13. zither /ð/
14. cousin
15. zest
16. razor (whistle)
17. trees
18. please (lateral)

/θ/ Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. θ - v
2. z - θ
3. θ - ʃ
4. θ - θ
5. f - θ
6. θ - s
7. θ - θ
8. t - θ
9. θ - θ
10. θ - ð
11. ð - θ
12. θ - θ

B. I am now going to read you a list of words. If the word has a /θ/ in it write YES on your paper. If it doesn't have a /θ/ in it write NO on your paper.

1. voice
2. zeal
3. thieves
4. milkshake
5. thirsty
6. symphony
7. truthful
8. beanstalk
9. breakfast
10. arithmetic
11. mother
12. oaf
13. sheath
14. mouthe
15. thermostat
16. sympathy
17. lengthening
18. birth
19. together
20. that

C. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully

1. birdbath
2. thrill /v/
3. throat /z/
4. thatch
5. teeth /ʃ/
6. northwest
7. tooth /f/
8. Thelma
9. thanksgiving /t/
10. everything
11. earthquake /s/
12. moth /ð/
13. worthwhile /f/
14. panther
15. thousand
16. tablecloth /ð/
17. strength
18. method (dist)
19. thug
20. athletic (dist)
21. thriller (dist)
22. mouthpiece (dist)

/ð/Program

A. Are these sounds the same or different? Write S in the blank if they are the same; write D in the blank if they are different.

1. ð - v
2. ʃ - ð
3. ð - d
4. ð - ð
5. ʒ - ð
6. ð - v
7. ð - ð
8. ð - θ
9. ð - ð
10. z - ð
11. θ - ð
12. ð - ð

B. I am now going to read you a list of words. If the word has a /ð/ in it write YES on your paper. If it doesn't have a /ð/ in it write NO on your paper.

1. dare
2. breeze
3. they
4. laid
5. father
6. loathe
7. player
8. zebra
9. measure
10. thee
11. vase
12. believe
13. either
14. ether
15. teethe
16. there
17. lather
18. breathe
19. thigh
20. teeth

C. Is this the right way to say these words? If it is the right way write YES in the blank space. If it is not write NO in the blank space. Listen carefully.

1. bathe
2. mother /v/
3. clothe /d/
4. this
5. though /z/
6. smooth
7. although /θ/
8. thou
9. bother /ʒ/
10. feather
11. gather /v/
12. rather /θ/
13. seethe /ʃ/
14. smother
15. lathe
16. that /d/
17. those
18. writhe
19. than (dist)
20. altogether
21. paths (dist)
22. other (dist)

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15. ABSTRACT *(250 words max.)*

This report discusses the results of a two-year demonstration project in which school age children with functional articulation disorders routinely received auditory discrimination training by programmed instruction in an actual clinical setting. Auditory discrimination programs for the ten most frequently misarticulated English consonants were written, evaluated and used with the appropriate portion of the clinic population. Pre-and post-program test scores on measures of articulation, general auditory discrimination, and discrimination of the sounds related to program content were gathered. This report describes the programs, the instrumentation developed for entirely automated program presentation, and changes in post-program test scores. The effects of routine use of programmed instruction within a more conventional clinical setting is also considered.

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